Vol. LXXXIII FEBRUARY, 1926 No. 2

ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

Edited by

LEWIS STEPHEN PILCHER, M.D., LL.D.

of New York

With the Association of

JAMES TAFT PILCHER, B.A., M.D.

and the Collaboration of

W. SAMPSON HANDLEY, M.S., M.D., F.R.C.S.

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ANNALS of SURGERY

VOL. LXXXIII FEBRUARY, 1926 No. 2

CANCER OF THE HEART*

SECONDARY TO CANCER OF THE BREAST BY DIRECT LYMPHATIC EXTENSION

BY ROBERT KAPSINOW, M.D.

OF NEW HAVEN, CONN.

CARCINOMA of the heart, secondary to that of the breast, is so uncommon a condition, that it is of great interest to report the following case. A diligent search of the literature has failed to reveal any case of this nature.

REPORT OF CASE

Mrs. E. H. (St. Agnes, No. 34,988) was admitted to the Surgical Service of Dr. Joseph C. Bloodgood, in St. Agnes' Hospital, of Baltimore, Md., September 24, 1924.

She first noticed a lump in her left breast about May, 1922, but neglected to have medical attention for six months. At that time she was advised to have the breast removed but put it off for another six months. On July 6, 1923, she had a radical breast operation performed by Doctor Swope, of Pittsburgh.

In May, 1924, the patient began to have shortness of breath which was frequently associated with agonizing pains in the precordium radiating to the base of the neck and to the back. These pains were becoming so frequent, that she required large doses of morphia.

FIG. 1.—Cross-section of base of heart showing involvement of aorta and pulmonary vessels in cancer mass.

Shortly after the onset of the pain, she noticed small B. B. shot growths about the scar of the old operation. On examination, she showed a scar of the previous operation, about which were found numerous B. B. shot skin metastases. These were found chiefly about the lower end of the scar. The axilla was free of any involvement.

Vocal fremitus was increased throughout both sides but the resonance was impaired only at the left side of the precordium. Breath sounds were harsh. There did not seem to be any evidence of fluid in the chest. The heart sounds were very faint. No murmurs could be heard.

The abdomen was distended and tender. The liver edge was palpable three finger-breadths below the costal margin. No fluid present in abdomen.

X-ray examination by Dr. Max Kahn revealed a cloudy shadow to the left of the heart extending up to the fifth rib which was interpreted as fluid.

Laboratory findings: Red blood-cells, 4,424,000; white blood-cells, 11,000; hæmo-

*From the Surgical Clinic of St. Agnes' Hospital of Baltimore, Md.

globin, 70 per cent.; polymorphonuclears, 68 per cent.; large mononuclears, 3 per cent.; small mononuclears, 27 per cent.; transitionals, 2.0 per cent. Urine—trace of albumin.

The condition of the patient became progressively worse. The attacks of pain were typical of angina pectoris usually due to coronary occlusion. She died during one of these attacks on October 4, 1924, ten days after admission.

Autopsy Findings.—The skin and subcutaneous tissue of the left chest was found to be studded with cancerous nodules, extending downward to the interspaces of the ribs.

On lifting the chest wall, it was found that the carcinomatous tissue had invaded the anterior mediastinum. The lymph-nodes behind the xiphoid were enlarged to the size of a hen's egg, protruding into the left pleural cavity. These masses were yellowish-white in color and cut like cartilage. The entire pericardial sac was thickened and leathery in feeling and showed gross cancer. At no point was the pericardium adherent to the heart.

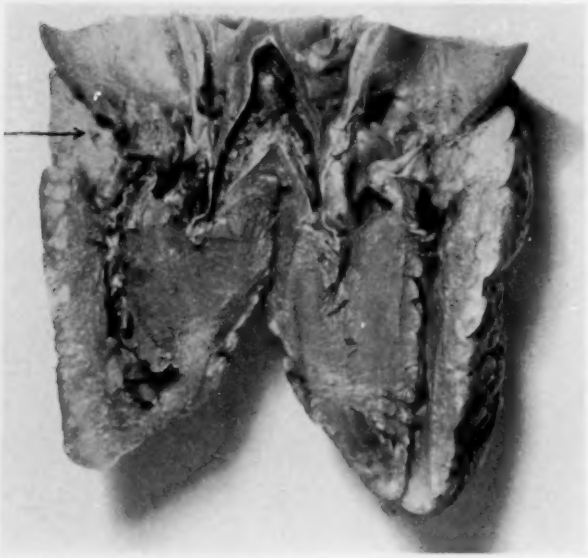

FIG. 2.—Longitudinal section of heart. Auricles consist chiefly of solid cancer tissue. Coronary artery can be seen imbedded in the mass.

At the base of the heart, the cancerous invasion was enormous. The tumor tissue was found compressing the pulmonary and aortic vessels for a distance of 2 inches (Fig. 1). It extended downwards, replacing all the muscular tissue of the auricles and even into the ventricles. The endocardium and valves were grossly normal in appearance. The right coronary was completely imbedded in firm cancerous tissue so that a probe could only be inserted into the vessel with difficulty (Fig. 2).

Neither lung showed any malignant invasion. There was a small amount of bloody fluid present in the left pleural cavity.

On the superior surface of the liver, numerous white areas measuring 2 to 15 mms. in diameter were found. There was no deep invasion. The gall-bladder and common duct were studded with cancer nodules. The head of the pancreas and the omentum likewise contained cancer nests. The other viscera were essentially normal.

Histological Findings.—Sections taken from the pericardial sac demonstrates typical scirrhous cancer. The superior mediastinal lymph-nodes are entirely filled with rapidly growing malignant cells (Fig. 3). Specimens taken from the auricles demonstrate strands of cancer tissue permeating between the muscle fibres (Fig. 4).

The involvement of the liver suggests that here the invasion is from the peritoneal surface inward producing a cone-shaped nest. These nests are produced by retrograde lymphatic invasion. The subperitoneal lymphatics of the gall-bladder and common duct are filled with rapidly growing cancer cells. In the pancreas, the strands of invading tissue seem to follow the course of the blood-vessels.

Description of Lymphatic Channels Involved.—The afferent lymphatic vessels of the breast empty into the axillary lymph-nodes of both sides, retro-

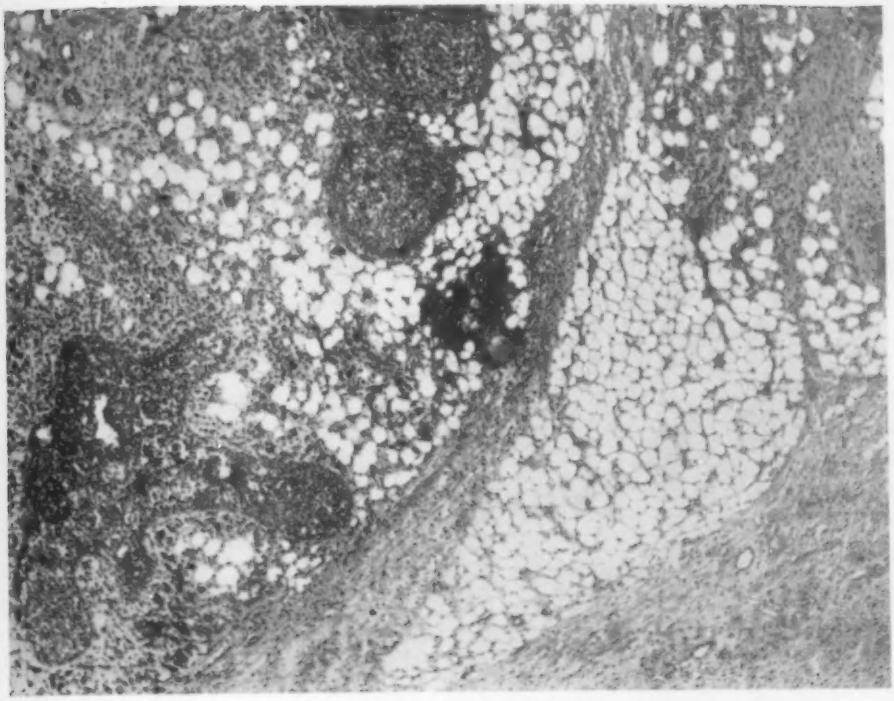

FIG. 3.—Extensive invasion of a supra-cardiac lymph-node.

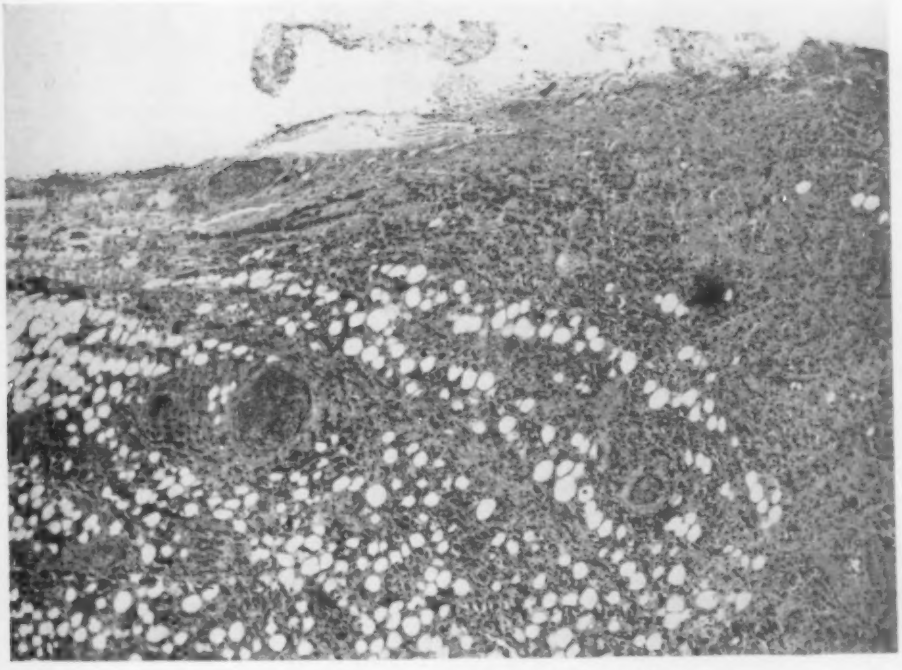

FIG. 4.—Muscle fibres of the auricle permeated by strands of cancer tissue.

pectoral, retrosternal, supraclavicular and paramammary nodes. This may be called the primary circulation. This system is correlated with a secondary distribution consisting of lymph vessels draining into the deep cervical, diaphragmatic, hepatic, supraxyphoid, intercostal and inguinal nodes.

From a statistical study of secondary invasion from the primary source, it seems that the hepatic division is the most important of the secondary circulation. The importance of any individual group of secondary nodes depends upon the extent of the primary invasion. This is difficult to determine at the time of the operation. For this reason one cannot foretell where the metastatic growth might occur.

In this particular case, it seems as though the original growth extended towards the retrosternal lymph-nodes of the primary circulation by following the perforating branches of the internal mammary artery. These trunks are subject to early senile atrophy and hence accounts for the infrequency of retrosternal involvement.

From the retrosternal nodes, the tumor extended through the lymphatics of the anterior mediastinum to the base of the heart and downwards through the hepatic channels to the liver, gall-bladder and pancreas. The invasion of the heart must have preceded the abdominal growths by several months, judging from the size alone.

It is unusual that there should be no pulmonary metastases with such extensive invasion of the heart and pericardium.

SUMMARY

An unusual case of carcinoma of the heart, secondary to that of the breast, is reported. The distribution indicates that the growth was a retrograde invasion by direct continuity along the lymphatic channels described.

I wish to express my appreciation to Dr. Joseph C. Bloodgood for his kind assistance in the study of this case.

THE DEVELOPMENT OF CARCINOMA IN SCAR TISSUE FOLLOWING BURNS*

By Frederick M. Johnson, M.B., Tor.

of Atlanta, Ga.

The formation of carcinoma in scar tissue constitutes a rare, but nevertheless a well recognized clinical entity. As early as 1828, Marjolin [1] emphasized the importance of the condition and for many years in the French medical literature such tumors were associated with his name.

Cutaneous cicatricial tissue resulting from any form of injury may, under certain circumstances, become the seat of malignant transformation. Thus epithelioma develops in the scar in a considerable proportion of cases of lupus vulgaris, and less frequently with lupus erythematodes (Ashihara [2]). Da Costa [3] has stated that fully 18 per cent. of lupus cases develop carcinoma after X-ray treatment. This should not be interpreted, however, as indicating that radiation is responsible, because epithelioma is by no means uncommon following other methods of therapy. It would appear therefore that the cicatrix itself is suitable soil for malignant growth.

The scar of an ordinary injury is not immune. Just [4] has reported in reference to a man, age thirty-nine, who developed squamous-cell carcinoma in the scar of a wound produced by a rock-cutting instrument. The injury required three months to heal, and four years later, following an abrasion, cancer appeared, which metastasized very rapidly with a fatal result. Volkmann's [5] patient received a lacerated wound of the calf of the leg when a young man. After an interval of thirty-five years the scar ulcerated, became malignant and grew with marked momentum.

Other varieties of injury, such as dog-bite, or freezing (Eckermann [6]), have preceded scar carcinoma. Dupuytren [7] has pointed out the possibility of cancerous change in cicatrices during the decline of life, and described two instances in which malignant disease supervened on the scar of an amputation stump. Ruchaud [8] has observed cancer on many varieties of scars such as old osteomyelitic foci and perineal fistulæ; but it is on burned areas that this accident occurs most frequently. Durand's [9] thesis is illustrative; in 90 cases of degenerated scars 70 were caused by old burns. Baasner [10] was able to collect 33 instances from the German literature prior to 1900.

In the space of a year four cases of ulceration occurring in the cicatrix of extensive burns have been observed at the Steiner Clinic of Atlanta, Ga. Of these, three were proven microscopically to be squamous-cell carcinoma, while the fourth was benign in character but clinically precancerous.

Case I.—M. J., a female, age thirty-two, was severely burned when three years old. Healing was not complete until four years had passed. Twenty-three years later, an ulcer appeared in the scar overlying the right hip. As it slowly grew, pain became

* From the Radium Department of the Steiner Clinic.

severe, and for this an operation was performed by an army surgeon in Honolulu, after which skin grafting was attempted, but with no success.

The woman was healthy except for a huge, deep neoplastic ulcer measuring 20 x 30 cms. in diameter, overlying the right great trochanter. Surrounding the ulcer was a pale, smooth, glistening, fixed scar which extended upwards and inwards to fill the groin. There were no enlarged lymph-nodes.

Treatment consisted of cautery excision of the tumor and adjacent scar followed by skin grafting. During the next two months there were three small recurrences, all being superficial and easily removable. The wound has been healed and free of palpable tumor for a period of eleven months.

Case II.—E. D., a female, age forty-five, fell head first into an open fire when four months old. The wounds were unhealed for eight years. Ten years previous to admission to the clinic an ulcer appeared back of the forehead.

When admitted the face was hideously deformed. The anterior half of the scalp was devoid of hair and replaced by a shiny, firm cicatrix. Overlying the right parietal bone was a thick, laminated, adherent crust covering a superficial ulcer 3 x 2 cm. in size. There were no enlarged cervical lymph-nodes. The clinical diagnosis was acanthoma, which was confirmed microscopically by the study of a minute piece of the ulcer edge.

Treatment.—Surgical excision was advised, but this the patient steadfastly refused. Finally the ulcer was treated by means of silver filtered, radium emanation tubes, held in place by dental modelling compound with the result that a neoplastic ulcer has been converted into an indolent benign ulcer.

Case III.—J. E., a female, age sixty-nine, was badly burned on the right forearm at the age of eight. The wound never completely healed and for sixty-one years she had worn an arm dressing. Three years ago the ulcer commenced to discharge profusely and to give off a bad odor. For six months there had been rapid decrease in weight, the pain had been severe and several weakening hemorrhages had occurred.

The patient when admitted was in a semi-conscious state. The temperature ranged from 97 to 103° F., and the pulse from 120 to 140 beats per minute. The red blood-cell count was 1,840,000, white blood-cell count 15,250 and hæmoglobin 30 per cent. The right elbow and wrist were fixed in partial flexion by stout bands of scar tissue. On the front of the forearm, beginning at the wrist and extending upwards halfway to the elbow, was a bulky, excavating ulcer with depressed necrotic base, and with raised, typically neoplastic edges. The ulcer margins practically became confluent on the dorsal surface. There were no enlarged axillary nodes.

Treatment.—To relieve the patient of a foul, painful, septic focus, amputation at the mid-portion of the upper arm was performed rapidly, using novocaine anæsthesia. The wound healed well, and in a few days the general condition was better, the mind was clearer and the blood picture more normal. There has been no return of the tumor during a period of a year.

Case IV.—D. W., a female, age thirty-eight, was burned on the right thigh and abdomen thirty-one years previously. Two years were required for complete healing. During the last six years, an area in the scar of the loin had ulcerated and healed several times.

The scar of the flank presented an ulcer 10 x 15 cm. in diameter. It was very superficial, and had smooth edges and a glazed indolent base. It lacked the characteristic vigorous overgrowth of cancer. No enlarged nodes were felt.

Treatment.—Cautery excision and skin grafting were performed. The microscopical report on the tissue removed was benign ulceration with no precancerous tendency. The new scar has remained healthy for about eight months.

Etiology.—Epithelioma of the skin is induced almost exclusively by the chronic injury of previously normal or abnormal tissue. It is not difficult to

understand how a defect in the regeneration of burned skin, would, if subjected to irritation, provide a suitable medium for unrestrained cell growth. Hulke [11] has written that malignant disease occurs on scars of slow formation and that pliable cicatricial tissue is not dangerous. This at once indicates the desirability of skin grafting as a measure to be adopted early in the treatment of burns. The lesions that I have seen are in strict accord with Hulke's observation. In the third case repair was never complete, and, incredible as it may seem, the patient was content to wear a dressing for sixty-one years.

Sex.—Although the cases reported here are all females, scar cancer, like skin cancer in general, occurs more frequently in men because of the greater likelihood of inciting factors.

Age.—Scar carcinoma is not restricted to the old or middle aged. The ages of the patients in this series are 32, 45, and 69. It would seem, therefore, since the burn in each case occurred in early childhood, that the age of the scar and not of the subject is the more important.

Location of Ulcer.—Those parts of the body most liable to exposure will be most likely to undergo scar change. According to Ruchaud [8] these are in order, arm, leg, head and trunk. He further noted, that the upper arm is affected more often than the forearm and the thigh more often than the leg.

Symptomatology.—The development of scar cancer is insidious. Ruchaud [8] who had an unusual opportunity for studying the early manifestations, described the various origins as follows:

(*a*) A small, indolent and itchy papule is often the beginning, at first firm and resistant, later becoming moist and ulcerated.

(*b*) Occasionally a true keloid forms and the cicatrix is lifted entirely. This tumefaction is painful and ulcerated at its centre, and the hardened edges turn outwards, forming thereby a typical cancroid.

(*c*) In a very great number of cases the scar loses its integrity before becoming epitheliomatous. Ulceration is provoked frequently by the patient who scratches at a cicatrix which in the course of time has become pruritic. The surface is covered later with squamous plaques which, when rubbed off, are replaced by small sanguinous ulcerations. Fissures are formed which fuse, and the true ulceration is constituted. The physician thinks, then, of a simple irritative lesion, but the hyperæsthesia and tumefaction, even at this period, serve to give the diagnosis.

(*d*) Accidental opening of a scar is frequent, and the tissue repairs itself only very slowly, if not hindered by constitutional disease nor local dyscrasia. The patient disregards the scar, and the wound gradually increases at the expense of the neighboring parts.

Type of Cancer.—I am unable to find in the available literature any reference to basal-cell carcinoma appearing on scars of burns. The squamous-cell variety is invariable, and the flat, indurated infiltrating type is more frequent than the papillary of which only a few examples are described. (Marjolin,[1] Scagliola.[12])

Progress of the Disease.—When well established the rate of growth is

slow, slower in fact, than with cancer of healthy skin (Verdelet [13]). This may be accounted for by the anæmic state of the usual thick scar. Most writers are agreed, however, that once there is deep invasion of the underlying muscle tissue, conditions are reversed, and an abundant blood supply nourishes the malignant cells for the production of a growth which quickly destroys (Boegehold,[14] Mollière [15]). Mohr's [16] patient, following amputation of an arm, rapidly weakened and died from pulmonary hemorrhage. Autopsy revealed extensive metastatic deposits in lungs, pleura, heart and kidney. Durand [9] reported a case of carcinoma developing in the cicatrix of a burn in the region of the knee which produced metastases to iliac, pelvic and lumbar lymph-nodes and a tumor in the liver as large as an orange. Such extensive generalization is unusual in squamous-cell cancer of any situation, and it shows very strikingly that under proper conditions of growth, scar carcinoma is capable of very active behavior. Heidingsfeld [17] observed a tendency to spontaneous repair, but it is doubtful if the scar degeneration in this instance had reached the malignant state. From a consideration of these and other references it would appear, that although a few observers have been inclined to consider cancer arising on scars of burns a relatively benign lesion, practically all hold the opinion that the disease may and does follow a very malignant course, and while it is less formidable at the beginning, the cells take on a more embryonic type as it advances.

Treatment.—This naturally resolves itself into prophylactic and curative.

Prophylactic.—Proper surgical care at the time of the burn will do much towards the prevention of thick, rigid delayed scars. Modern hospital facilities, and the general adoption of skin grafting has improved the character of cicatricial tissue to such an extent that this type of malignant disease will be encountered much less frequently as time goes on. Once a disfiguring and band-like scar has formed, there remains always, the potential danger in later years. This can be minimized by the protection of the scar against all forms of injury such as friction of clothing, irritation by dirt and insects, prolonged suppuration, and accidental wounds.

Curative.—Curative treatment is strictly surgical. In the reported cases which have been reviewed, no mention was made of the use of physical agents except by Heidingsfeld [17] who used X-ray in a very advanced case, without apparent success. Since the curative value of radium and X-ray depends in a large measure on local tissue reaction and adequate blood supply, the use of these agents in the treatment of a tumor with a scar tissue foundation would be unwarranted. In the second case of this series an indolent benign ulceration is the undesirable result of radium treatment. Surgical excision, still is being constantly advised, and still as constantly rejected by the patient.

The management of metastatic nodes when accessible is likewise a surgical problem which must be faced aggressively. The region should be subjected to Röntgen-ray exposures, both before and after excision. The use of

unfiltered emanation tubes in the wound at the time of operation is of definite value.

I agree whole-heartedly with de Nancrède [18] when he says that although cancerous change in scars of burns is taught in books and lectures, very few believe in its actual occurrence. A knowledge of the potential danger that rests in old cicatricial tissue at once points the way to prompt removal of the first break in continuity, whether it be benign or malignant in character.

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TUBERCULOSIS OF THE BREAST*

AS OBSERVED AT BELLEVUE HOSPITAL OF NEW YORK CITY

By J. William Hinton, M.D.

of New York, N. Y.

ADJUNCT ASSISTANT VISITING SURGEON, BELLEVUE HOSPITAL

AND

Theodore C. Lawson, M.D.

of Berkeley, Cal.

HOUSE SURGEON ON THE FOURTH SURGICAL DIVISION OF BELLEVUE HOSPITAL

To the literature on this subject which has been thoroughly reviewed in the past few years by Elkins,[1] Leavitt,[2] and Cahill,[3] we wish to add a case which has come under our observation on the Fourth Surgical Division of

Table I.

Abstract of Cases of Tuberculosis of the Heart Treated at Bellevue Hospital of New York City

Case	Date	Age	Sex	F. H.	P. H.	Present nursing children	Duration	Trauma	Pain	Tenderness
No. 1 A.B. "14506"	7/24/11	30	F	Neg.	Neg.	O	3 mos.	O	X	X
No. 2 M.M. "741"	1/27/13	23	F	Neg.	Neg.	O	6 mos.	O	X	O
No 3 M.H. "5430"	8/15/16	20	F	Neg.	Neg.	O	3 mos.	X	X	X
No. 4 M.A. "8027"	12/16/16	54	F	Neg.	Neg.	O	8 mos.	O	X	X
No. 5 M.G. "773"	2/ 3/19	25	F	Neg.	T.B. Adenitis	O	4 yrs.	O	O	O
No. 6 L.L. "5317"	7/27/19	35	F	F. died T.B.	Abscess right neck	O	1 yr.	O	X	X
No. 7 E.Mc. "1283"	5/13/22	26	F	Neg.	Neg.	O	2 yrs.	O	O	X
No. 8 M.W. "627"	3/30/25	65	F	Neg.	Chr. dry cough 8 yrs.	O	2 mos.	O	O	O

* We are indebted to Dr. Carl G. Burdick, Director of the Fourth Surgical Division, for the privilege of reporting this case, and Dr. Douglas Symmers, Director of Laboratories for the privilege of using the pathological material of this series. Also Drs. R. S. Hooker, Harold E. Santee and George D. Stewart, Directors of the First, Second and Third Divisions, respectively, for the privilege of reviewing the cases on their divisions.

TABLE II.

Case	Side	Quadrant	Size	Sinuses	Skin	Retraction of nipple	Glands	Other foci
No. 1 A.B. "14506"	L	Middle below nipple	Whole breast	O	O	O	O	Lungs clear.
No. 2 M.M. "741"	R	Middle upper half	Goose egg	O	O	O	O	Lungs clear.
No. 3 M.H. "5430"	R	LLQ	Walnut	O	O	X	Cervical old	Old cervical glands. Lungs clear.
No. 4 M.A. "8027"	R	RUQ	3×4 cm.	O	O	O	O	Lungs clear.
No. 5 M.G. "773"	L	LUQ	LUQ of breast	X In L axilla	X Retraction	O	Cervical and axillary	Râles in L apex of lung.
No. 6 L.L. "5317"	L	LUQ	Diameter 1½ inches	O	O	O	O	Old healed abscess on rt. neck.
No. 7 E.Mc. "1283"	R	LLQ	4×3 cm.	O	O	O	Enlarged rt. axillary gland	Lungs neg.
No. 8 M.W. "627"	R	RUQ	Diameter 3 cm.	O	O	X	X Along axillary border	Dullness and X-ray of lungs.

TABLE III.

Case	Wassermann	Pre-op. diag.	Path. diag.	Treatment	Result (discharge)
No. 1 A.B. "14506"	Neg.	Abscess of breast	T.B. and suppurative mastitis	Incision and drainage. Biopsy	Cured.
No. 2 M.M. "741"	None	T.B. of breast	T.B. of breast	(1) Biopsy. (2) Simple mastectomy	Improved.
No. 3 M.H. "5430"	Neg.	T.B. (abscess) of breast	Chronic mastitis miliary tubercles	Simple mastectomy	Improved.
No. 4 M.A. "8027"	Neg.	Ca. of breast	Tuberculosis of breast	Radical mastectomy	Cured.
No. 5 M.G. "773"	None	T.B. of axilla and chronic mastitis	T.B. of lymph-nodes, probable T.B. of breast	Radical mastectomy	Cured.
No. 6 L.L. "5317"	None	Ca. of breast	Adenocarcinoma of breast and T.B.	Radical mastectomy	Cured.
No. 7 E.Mc. "1283"	Neg.	Ca. of breast	Intracanalicular adenofibroma and T.B. lymph-nodes breast	Radical mastectomy	Cured.
No. 8 M.W. "627"	Neg.	Ca. of breast	T.B. of breast	Radical mastectomy	Cured.

Bellevue Hospital and also review the cases which have occurred on all of the divisions since 1911. The symptomatology and physical findings in this series have not agreed with some of the previous reports, and we present the tabulated findings in the eight cases which have occurred in the hospital during this period of time. (See Tables I, II, and III.) Tuberculosis of the breast is spoken of as being primary and secondary. In our case it was presumably secondary to a chest condition which was not diagnosed either clinically or by the röntgenological department, but in reviewing the plates after the pathological report had been received, the findings would point to tuberculosis.

The X-ray of the chest wall April 7, 1925, No. 117756, showed: "Moderate degree of dilatation of the aortic arch. No enlargement of heart to left. Marked enlargement of the lymph-nodes at the right root. Two small localized areas of infiltration in the basal portion of the right upper lobe, suggesting metastatic lesions."

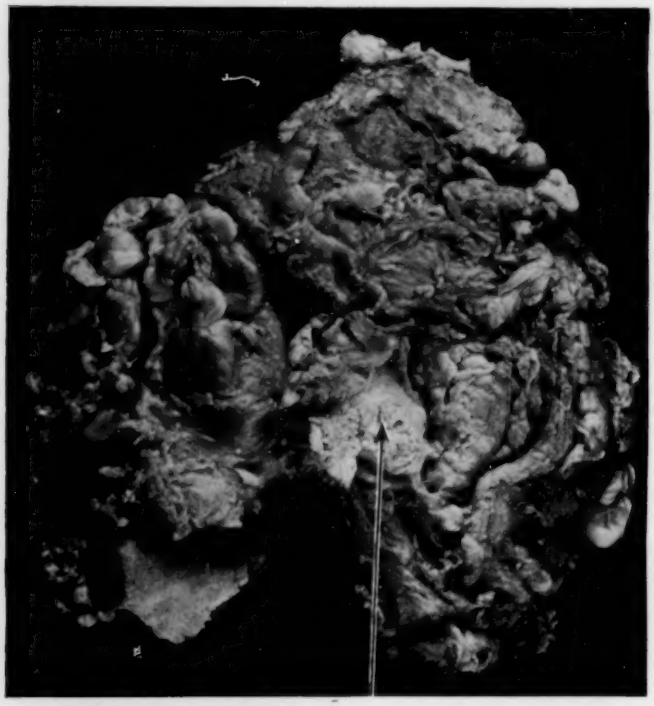

FIG. 1.—Shows gross appearance of mass in the breast tissue after it was sectioned.

In this series the average age was 34.7 years, the oldest 65 and the youngest 20 years. All were in females and none of them were nursing at the time the enlargement was first noticed. The duration of the history averaged one year and five months, the longest being four years and the shortest two months.

The pre-operative diagnosis was made in three of the eight cases. The chief point of interest in the history of this condition is pain which was present in five of the eight patients. Cahill [3] states that pain is a late symptom, but this was not true in this series. On physical examination five of the eight patients complained of tenderness over the enlargement which is not usually encountered in cases of malignancy. Some authors state that the upper and outer quadrant is more frequently involved. This series showed practically no difference in the relation of the quadrants that were affected. The axillary lymph-glands were found enlarged in three cases. There seemed to be

no difference in the sides involved, as the right was affected in five and the left in three. The nipple was retracted in two, and the skin was retracted in one case. We did not find the typical "pig skin" appearance over the tumor which is frequently described. A Wassermann was done on five of the eight patients, and in all of these it was negative. A history of trauma was obtained in one case. Physical examination of the chest revealed râles in two of this series. Evidence of a previous cervical adenitis was found in two cases. The family history of tuberculosis was negative except in one case. One gave a history of having had a dry cough for approximately eight years, without expectoration.

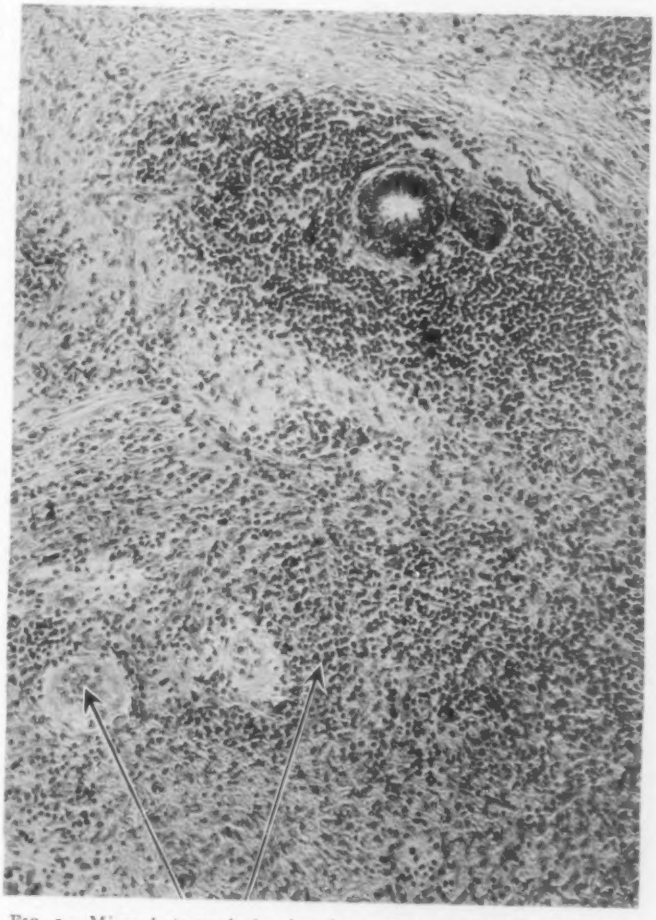

FIG. 2.—Microphotograph showing giant cells and lymphoid infiltration.

CASE HISTORY.—M. W., sixty-five years, widow. Two months before admission to Bellevue Hospital, while bathing, noticed a lump in her right axilla at the anterior axillary border; size of a cherry, non-tender, movable, not adherent to skin. This gradually grew in size to 4 x 3 cm. Three weeks later, or five weeks ago, noticed a similar lump in right upper quadrant of the right breast, not adherent to skin, freely movable, discrete, non-tender, about size of cherry, gradually growing in size to 2½ to 3 cm. in diameter. No other lumps felt. One week ago noticed beginning retraction of right nipple. No discharge. Loss of weight, 55 pounds in last year. Appetite poor for past two months. No nausea, vomiting, etc. Personal history, negative for tuberculous carcinoma, diabetes or serious illnesses. Usual childhood diseases. Has a chronic dry cough. Slight dyspnœa on exertion noticed during winter months for past eight years. No expectoration, hæmoptysis, pain, night sweats, etc.

Family history negative for tuberculosis, cancer, diabetes, nervous or venereal diseases. Three children. All grandchildren well.

Physical examination: General, elderly and fairly well developed and nourished

woman of about sixty-five not appearing acutely ill, walking about, showing no evidence of marked or sudden loss of weight.

Chest: Expansion fair, equal on both sides, and symmetrical.

Lungs: T. F. normal. Dulness at right apex over sternum and right sternal border and distant breathing. No bronchial breathing. No râles or pleural friction rub. Left breast negative. Right breast normal in size, nipple retracted; no discharge. About 4 cm. to right and above nipple is a small non-tender mass, discrete, freely movable, moderately indurated, not attached to skin, about 3 cm. in diameter. Along the anterior axillary border in the lower right axilla is a similar mass, 3 x 4 cm., showing same characteristics as above mass. No œdema or pig skin appearance. No other mass or nodes felt in breast, axilla or supra- and infraclavicular regions.

Pre-operative diagnosis: Adenocarcinoma of right breast with metastasis to axillary lymph-glands.

Operation: Usual axillary pectoral extirpation.

Gross pathology: On sectioning the mass of the axillary lymph-gland and the tumor of the breast, thin pus was evacuated. The microscopic picture revealed tuberculosis of the axillary gland and breast tissue. Figure 1 shows the gross appearance of the mass in the breast after it was sectioned. Figure 3 is a microphotograph under low power, showing giant cells and lymphoid infiltration.

Pathological diagnosis: Tuberculosis of breast and axillary lymph-gland.

Patient made an uneventful recovery. Wound healed by primary union and patient was discharged from the hospital on the twelfth day.

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TUBERCULOSIS OF THE MAMMARY GLAND*

By Arthur M. Shipley, M.D.
and
Hugh R. Spencer, M.D.
of Baltimore, Md.

The frequency or rarity of a particular infection in a tissue depends, to a considerable extent, upon the ability of that tissue to provide the essentials necessary for the growth or destruction of a particular organism. Thus it is that tuberculous processes in the lungs and lymph-nodes are of frequent occurrence, while in such tissues as voluntary muscle, myocardium and mammary gland, this type of infection is an unusual condition.

With reference to the mammary gland, a review of the literature serves to emphasize the infrequency of tuberculosis of that tissue. Anspach,[1] in 1904, reviewed the literature up to that time and compiled a series of 77 cases. Deaver,[2] in a review of the literature from 1904 to 1914, compiled a series of 74 cases, including 5 from his own service. Elkin[3] in a review of the literature from 1914 to 1922, compiled a series of 29 cases, including 7 of his own, 3 of which had been previously reported by Cheever.[10] Elkin's series included cases reported by Miles,[4] Gatewood,[5] Durante and MacCarthy[6] and Hamilton.[7] Since 1922, a number of new cases have been added to the literature, notably by Leavitt,[11] who reported 2 cases, Engel,[15] who reported 1 case, Archibald,[16] who reported 1 case in a Sudanese, Chauvin,[17] who reviewed the literature and reported 3 additional cases, Raw,[18] who, in a study of 10,000 cases of tuberculosis seen in hospitals and in private practice, observed 7 cases of tuberculosis of the mammary gland, and Cahill,[12] who reported a case of tuberculosis in the mammary gland of a colored female aged thirteen years.

The incidence of tuberculosis of the mammary gland in comparison to all other lesions of that organ is brought out by the following figures:

In Deaver's[2] Clinic, tuberculosis made up less than 1 per cent. of all breast cases, or 2.5 per cent. of all benign breast lesions. Durante and MacCarthy,[6] in a series of 1933 mammary conditions, reported an incidence of 0.51 per cent. of mammary tuberculosis. Gatewood[5] reported 1.04 per cent. of all breast lesions seen at the Presbyterian Hospital, Chicago, 1906–1916, as tuberculous. Bloodgood[8] reported 6 per cent. of all benign breast lesions in his service as tuberculous. Scott[9] reported 1.31 per cent. of tuberculosis in a series of 1830 breast cases. Cheever,[10] in a series of 228 breast lesions, reported an incidence of 1.7 per cent. of tuberculosis. F. B. Mallory, in discussing the paper of Leavitt,[11] reported that in the pathologic examination of 2297 breasts, 14 of them, including the 2 reported by Leavitt, were tuberculous, an incidence of 0.6 per cent.

* From the Departments of Surgery and Pathology of the University of Maryland, School of Medicine.

Of the 180 cases collected by Anspach,[1] Deaver[2] and Elkin,[3] 120 presented no clinical evidence of tuberculosis elsewhere and were regarded as primary cases. In the cases collected by Deaver,[2] more than 70 per cent. occurred between the ages of twenty and fifty years. The literature in general indicates that the period of most frequent occurrence is between those ages.

As brought out by Durante and MacCarthy,[6] a number of terms have been employed to describe the various aspects of tuberculosis of the mammary gland.

In general, however, three main types may be distinguished, *i.e.*, the nodular or discrete and the confluent types as originally described by Dubar[13] and the sclerosing type as described by Scott.[9] In any type the lesion or lesions are practically always unilateral and are often confined to one quadrant (upper and outer—Halstead and Lecount).[14] In from 60 to 75 per cent. of all cases, the axillary lymph-nodes on the corresponding side are involved (Gatewood[5]).

In the nodular or discrete form, one or many firm discrete nodules may be felt, while in the confluent type, through the coalescence of smaller areas, larger and more or less irregular masses can be palpated. It is in these types that a more or less acute process is often noted, with redness of the skin over the area, fluctuation, eventually sinus formation and even superficial skin ulceration. Sections of these lesions present a picture somewhat resembling a chronic mastitis, with a grayish discoloration of the glandular and adipose tissue. In many instances, yellowish caseous areas with surrounding grayish zones are seen. Often pressure expresses a whitish-yellow necrotic debris from the dilated ducts. Sinuses filled with necrotic material may be present.

In the sclerosing type, analogous to the more chronic and fibrotic forms of tuberculosis elsewhere, the lesion is firm and irregular, and the breast is apt to be distorted. On section a diffuse fibrous mass with relatively little caseation is seen. Such fibrous areas may or may not be in relation to deeper-seated "abscess" masses. This type is more common in older women and is not infrequently mistaken for malignancy.

Retraction of the nipple and pigskin appearance may be seen in any of the forms. Clinically, the diagnosis is based upon the chronicity of the lesion, together with a tendency to infiltration and softening. The skin may ulcerate relatively early, and sinuses leading from the scrofuloderma to the underlying tuberculous area are often seen. When the lymph-nodes in the axilla and along the pectoral muscles are involved, they are usually not so hard as in malignancy.

The histological picture is usually adequate for a definite diagnosis. Bacteriologically, the organisms are found with difficulty. In the more obscure cases, positive information may be obtained through guinea-pig inoculation.

The following 10 cases of mammary tuberculosis have been observed in a series of 671 breast cases at the University Hospital, an incidence of 1.49 per cent. for all breast lesions studied.

CASE I.—Chart No. 9659-A. Surgical Pathology No. 431. Colored female, thirty-eight years old. Admitted October 31, 1905. She gave birth to one child at the age of sixteen years. Previous history unimportant.

The present illness began about one year ago, with a small lump in the right side of neck. The mass was not tender, but was painful on pressure. Later on, a lump appeared on either side of the neck, and two masses were noticed in the left breast. She had a cough with some expectoration, with occasional night sweats, but no loss of weight.

The physical examination showed many enlarged cervical glands with small sinuses leading from a number of them. There were several scars and keloids on the right side of the neck. The glands in the axillæ were enlarged and there were a number of sinuses. There were two lumps in the left breast, more or less independent of one another. The whole breast appeared more or less diffusely involved.

The pre-operative diagnosis was tuberculosis of the cervical and axillary lymph-nodes and of the left breast.

The entire breast and all the axillary nodes were removed.

Pathology: Diffuse tuberculous involvement of the confluent type with typical tubercles in the breast and axillary lymph-nodes.

CASE II.—Chart 9722-A. Surgical Pathology No. 463. White female, forty-two years old. Admitted December 21, 1905. Patient had five children. There was a history of a fall ten years before admission, at which time she struck the left breast on the corner of a step. It was painful for several days and later a small lump appeared in the left breast, which broke down with a serous discharge. It was treated with apparent cure. Six months before admission, the left breast became extremely painful and began to discharge from the site of previous injury.

The physical examination at the time of admission to the hospital showed no evidence of tuberculosis of the lungs. The left nipple was retracted, and there was an area of superficial ulceration 1 cm. in diameter at a point 5 cm. above the nipple. There was marked, though localized induration in the breast tissue beneath this area. The axillary lymph-nodes were not definitely enlarged.

The pre-operative diagnosis was carcinoma of the left breast. The left breast and axillary nodes were removed.

Pathology: Diffuse fibrosis, with dilated and cystic ducts and many typical tubercles. Caseation was not marked.

CASE III.—Chart No. 10844-A. Surgical Pathology No. 548. White female, forty years old. Admitted June 3, 1906. Had nine children. There is a history of one sister who was tuberculous, and the eldest son was a cripple.

Five months before admission, the patient noticed a lump in the right breast about the size of a marble, 2.5 cm. above the nipple. The mass was firm, but not sensitive; it had increased in size and surrounded the nipple. In the past two months, the lump had increased steadily in size, it became softer and was painful and tender. By gentle massage, the patient could express a greenish-yellow, foul-smelling discharge from the nipple. She was never able to nurse her children comfortably from the right breast after nursing her first child, and as a result used a breast pump.

The physical examination showed the patient to be of slight build and only fairly well nourished. There was no evidence of tuberculosis of the lungs. There was a mass about the right nipple, and the axillary nodes were enlarged.

The pre-operative diagnosis was carcinoma of the right breast.

Radical breast amputation was done.

Pathology: Confluent tuberculosis of breast with caseation and typical tubercles. The axillary lymph-nodes also showed tuberculosis.

CASE IV.—Chart No. 13042-A. Surgical Pathology No. 704. White female, forty-four years old. Admitted April 17, 1907.

The present illness began five weeks previous to admission, with the appearance of a lump in the upper and outer quadrant of the left breast. The pain radiated down the

left arm. The lump in the breast gradually increased in size. Previous to the appearance of the lump, there was poor appetite, some loss of weight with sallow skin and pale mucous membranes. The heart and lungs appeared normal. There was a small lump in the left breast near the nipple, which was freely movable, but the nipple was not involved, and the axillary glands could not be felt.

The pre-operative diagnosis was carcinoma of the left breast.

Radical breast amputation was done.

Pathology: Caseation, typical tubercles, moderate fibrosis.

CASE V.—Chart No. 1344. Surgical Pathology No. 3769. White female, sixty years old. There was no history of this patient, except of a preëxisting tuberculous involvement of the right axillary lymph-nodes.

The pre-operative diagnosis was tuberculosis of the right breast and axillary nodes.

Resection of the breast and axillary nodes was done.

Pathology: Sclerotic tuberculosis of the breast; tuberculosis of the axillary glands.

CASE VI.—Chart No. 4131. Surgical Pathology No. 4308. White female, sixty-one years old. Admitted November 28, 1916, with a non-painful lump in the right breast of two weeks' duration. Seven months before admission a number of tuberculous nodes were removed from the right axilla.

The physical examination showed a lump in the right breast, 2.5 cm. in diameter, firm, not attached to the skin and not tender. There was no retraction of the nipple. Otherwise the examination was negative.

The pre-operative diagnosis was tuberculosis of the right breast.

Resection of the breast was done.

Pathology: Many small cellular and caseous tubercles.

CASE VII.—Chart No. 7862. Surgical Pathology No. 5153. White female, twenty-five years old. Admitted September 3, 1917.

For the past year, the patient has had enlarged and swollen glands in the right axilla. These glands later broke down, drained and closed time after time. The right breast became swollen and tender.

The patient was well developed and well nourished. The lungs seemed clear of tuberculosis. There were several small sinuses in the right axilla, discharging a creamy muco-purulent material. The surrounding tissue was inflamed and indurated. The nodes were enlarged, fairly firm, and fixed to the skin and underlying tissue. The right breast was swollen and tender, and the skin was reddened. No definite nodules were felt in the breast.

The pre-operative diagnosis was tuberculosis of the right breast.

The breast and axillary nodes were removed.

Pathology: Confluent involvement, cellular and caseous tubercles.

CASE VIII.—Surgical Pathology No. 10104. White female, forty-two years old.

The patient was the mother of three children, and for some time before admission, noticed some superficial ulceration of the nipple. Her youngest child was eight years old. There was no discharge from the nipple.

When examined, there was some retraction of the nipple with superficial ulceration, and under the nipple in the centre of the breast, there was an area of induration. The margins of the indurated mass were indefinite, and there was a number of small firm lymph-nodes in the axilla.

The pre-operative diagnosis was carcinoma of the breast with Paget's disease of the nipple.

Radical breast amputation was done.

Pathology: Diffuse fibrosis with numerous tubercles, little caseation.

CASE IX.—Chart No. 43246. Surgical Pathology No. 13288. White female, thirty years old. Admitted May 6, 1925.

The patient has one child aged six years.

Family history and past history were negative.

The present illness began two weeks before admission, with a painful lump in the left breast, and for two days the nipple has been retracted.

The physical examination was negative except for the breast. The central portion of the left breast was occupied by an indistinct mass, not very hard, but quite tender, which was attached to the deeper structures. There was some retraction of the nipple, but no discharge. There was a fever of 100, and the patient complained considerably of pain and tenderness in the breast. No enlarged glands could be felt.

The pre-operative diagnosis was chronic inflammation.

Resection of the mass was done.

Frozen section at time of operation eliminated malignancy.

Pathology: Mass in central portion of breast, worm-like casts of ducts extruded when mass is squeezed.

Microscopic: Many cellular and caseous tubercles. Many giant cells, confluent process.

CASE X.—Chart No. 43265. Surgical Pathology No. 13292. White female, fifty-nine years old. Admitted May 7, 1925.

The patient was told five years ago that she had tuberculosis, but, with the exception of a slight non-productive cough, she has been well up to the present illness, which began one year ago, when she noticed a small mass in the lower portion of the right breast. This had gradually increased in size. Three months ago the skin over the mass became ulcerated. She has lost about ten pounds in weight and now has a productive cough and occasional night sweats.

There was found on examination a movable tumor in the outer hemisphere of the right breast in the anterior axillary line about the size of a small orange, hard, indurated, fixed to the underlying structures, with superficial skin ulceration and a foul discharge. The axillary nodes were large. There were many fine râles heard in the right lung. X-ray examination showed pleural involvement and apparently metastatic nodules in the right lung.

The pre-operative diagnosis was ulcerating carcinoma of the right breast with metastases to lymph-nodes, pleura and lung.

Radical breast amputation was done.

Pathology: Marked diffuse fibrosis with moderate caseation, many giant cells.

SUMMARY

In the ten cases here reported, all have been in females. The average age was forty-four years—youngest twenty-five years—oldest sixty-one years. In one case there was a family history of tuberculosis. In one case there was a history of trauma. In five cases there was clinical evidence of preëxisting tuberculosis elsewhere. There was an involvement of the cervical lymph-nodes in one case and of the axillary nodes in six cases. In all cases the lesion was unilateral, with involvement of the right mammary gland in seven cases, and of the left in three cases. The lesions were single in five cases, multiple in two cases, and diffuse in three cases. The portion of breast involved was very irregular. There was skin ulceration in three cases, retraction of the nipple in two cases, discharge from nipple in one case, and sinus formation in one case.

The pre-operative diagnosis was tuberculosis in four cases, chronic mastitis in one case, and carcinoma in five cases.

There were no deaths in the series, and consequently no opportunity for post-mortem examination.

COMMENT

Tuberculosis of the mammary gland is of interest not only from the standpoint of its rarity, but also because of uncertainty as to the mode of infection and from the point of differential diagnosis. More than 60 per cent. of the cases reported have been classified as primary ones; these have, for the most part, been women who were otherwise in good health and in whom no clinical evidence of tuberculosis could be found.

It is recognized, of course, that tubercle bacilli from some preëxisting focus may reach the mammary gland through the blood stream and through the lymphatics, or by direct extension, with resultant secondary infection, but it is difficult to understand how, except by direct inoculation through cuts, abrasions, or through the lactiferous ducts at the nipple, breast tissue should be primarily involved any more than should tissues such as bone. Unfortunately, as Gatewood [5] has noted, in no reported case has there been a complete study of the body at autopsy, so that the question of the existence of a primary lesion in the mammary gland cannot be settled.

Halstead and Lecount,[14] Bundschuh [21] and Gatewood [5] were of the opinion that the majority of cases of mammary tuberculosis were the result of retrograde lymphatic involvement from the axilla or from some intrathoracic focus. This belief was based upon observation that in a number of instances the involvement of the axillary nodes seemed definitely to precede the mammary involvement, and this opinion is strengthened through the recognition of the intimate relationship of the mammary gland to the axillary and mediastinal lymph-nodes.

In our own series, three cases at least seemed the result of retrograde infection from the axillary nodes, one case apparently represented a retrograde infection from the cervical nodes, and one was secondary to tuberculosis of the lungs and pleura.

In a number of instances, Deaver,[2] Leavitt,[11] and others,[19, 20] and as shown in our own series, tuberculosis of the mammary gland is confused with carcinoma of that tissue, this is particularly true of the sclerotic type.

In five of our cases, the pre-operative diagnosis was carcinoma, but in two of these instances the character of the lesion at operation was such as to exclude malignancy, so that a less radical procedure was adopted.

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DIAGNOSIS AND TREATMENT OF FRACTURES OF THE SKULL AS DEVELOPED IN THE CINCINNATI GENERAL HOSPITAL

By B. N. Carter, M.D.
of Cincinnati, Ohio.
From the Department of Surgery, of the University of Cincinnati Medical College and the Cincinnati General Hospital

In the present report it is aimed to bring out as far as possible the relation between various clinical aspects and therapeusis of skull fractures. With these ideas in mind we present a study of 223 cases which represent the cases admitted to the Cincinnati General Hospital in 1922 and 1923, all of which with few exceptions have been personally observed and treated.

The procedure followed in this Clinic is to observe the patient for varying periods of time before any operative interference is offered, unless he presents a compound fracture, a depressed fracture, or signs and symptoms of an extradural hemorrhage, in which event he is operated on immediately provided his condition permits it. During this observation period various studies are made which form the basis for his subsequent management. These consist of a general physical and neurological examination, a record of pulse and respiration every twenty minutes, frequent temperature observations, an X-ray of the skull, and a spinal puncture with a record of the spinal fluid pressure.

To our minds the most important phase of the treatment is this observation period when one recognizes and interprets correctly the changing train of signs and symptoms and on them bases his subsequent procedures. Under observation patients fall into the following groups: *i.e.*, (1) those whose injuries are incompatible with life and who rapidly die; (2) those who show only mild degrees of injury and who never present alarming symptoms; and (3) those who stand between groups (1) and (2), whose outcome is problematical and whose management is both difficult and fascinating. An analysis of our cases shows the following:

Age.—Between 1 and 10 years of age, 41 cases—mortality 14.6 per cent.
Between 11 and 20 years of age, 29 cases—mortality 13.7 per cent.
Between 21 and 30 years of age, 31 cases—mortality 32 per cent.
Between 31 and 40 years of age, 36 cases—mortality 38.9 per cent.
Between 41 and 50 years of age, 29 cases—mortality 58.6 per cent.
Between 51 and 60 years of age, 25 cases—mortality 44 per cent.
Between 61 and 70 years of age, 21 cases—mortality 42.8 per cent.
Between 71 and 80 years of age, 6 cases—mortality 66 per cent.

These figures corroborate those of other observers as to the more favorable prognosis in children as compared with adults. This is due to several factors such as the greater elasticity of the bones, the lack of fusion of the suture lines, and the lack of adherence of the dura to the skull. It is less

often necessary to resort to decompressions in children, and one finds fewer cases with depressed fractures. It is interesting to note that the greater number of cases occurring in any one decade is found in the first. It is to be expected that after the age of 50 the mortality is increasingly high.

Sex and Race.—There were in the series 183 males (mortality 35.5 per cent.) and 40 females (mortality 36.1 per cent.). One hundred and eighty-six (mortality 38.2 per cent.) were in the white race and 37 (mortality 33.4 per cent.) in the colored. There is little of significance in the sex or race as such; since the severity of the injury is the most potent factor.

Type of Fracture.—Here one finds a marked variation in the mortality and there is much of prognostic value in the type of fracture. The most innocuous fractures are the simple fractures of the vault, whereas, the most serious are those involving the base.

Number of simple fractures of the vault, 59—mortality 13.5 per cent.
Number of simple fractures of the base, 33—mortality 42.4 per cent.
Number of simple or depressed fractures of the vault and base, 107—mortality 47.6 per cent.
Number of compound fractures of the vault, 8—mortality 12.5 per cent.
Number of compound, comminuted depressed fractures, 16—mortality 37.5 per cent.

Mixter,[2] in 1917, reported 301 cases of fractures of the base of the skull with a total mortality of 54.1 per cent. (but of only 36.5 per cent. in that part of the series from 1911–17). He, however, eliminated the cases with severe associated injuries and those which died within two hours, whereas, our series includes all cases. Ransohoff,[3] in 1910, reporting on 190 cases of fracture of the base of the skull, shows a mortality of 65 per cent., and quotes Cushing as having a mortality of 80 per cent. before he began to do decompressions. Phelps [4] reports 570 cases of fracture of the base with a mortality of 54.5 per cent., and 213 cases of fracture of the vault with 28.6 per cent. Crandon and Wilson [5] show 530 cases of fracture of the base with 41 per cent. mortality. The compound fractures of the vault do extremely well with immediate operation. They rarely show marked signs of pressure as they tend to decompress themselves through their wounds before operation. The compound, comminuted depressed fractures with extensive cortical laceration and associated basilar injuries are of most grave prognosis. The simple depressed fractures of the vault offer a good prognosis and are best treated by immediate elevation of the fragments.

Mode of Injury.—One hundred and eleven of the 233 cases were caused by automobiles, *i.e.*, about one-half of all our cases; and of the 80 cases in the series that died 52 per cent. were due to the automobile. This emphasizes first the importance of the automobile as a factor in producing skull fractures and, secondly, the seriousness of the injuries thus sustained. The injuries caused by the automobile are usually very extensive ones and are so often associated with fractures of other bones, " stove-in " chests or intra-abdominal injuries. One particularly fatal form of injury as noted by us are those cases which receive a very forcible blow on the point of the jaw with a

fracture of the jaw and a fracture from indirect violence to the base of the skull. Of these we have had 6 cases, all of which died within a few hours.

State of Consciousness.—Much stress was laid on the state of consciousness as of value in prognosis and as a guide in treatment by early writers, such as Hippocrates, Pare, Quesnay, Potts and Abernethy. Of our 223 patients 47 were fully conscious on admission, and of these 3 died—a mortality of 6.4 per cent. Sixty-six were semi-conscious, of whom 5 died—a mortality of 7.5 per cent. As against these two classes of cases was that in which the patients were unconscious on admission and remained so for a varying period of time, of whom there were 107 with a mortality of 66.3 per cent. In 3 cases no mention was made of the state of consciousness. Phelps [6] reports that of 542 cases of fracture of the skull with unconsciousness 318 died, of 76 practically conscious 30 died, of 289 who were conscious 80 died. In Ransohoff's [3] cases of fracture of the base 95 per cent. showed some change in the state of consciousness, and of 98 cases in deep coma 70 per cent. died. The state of consciousness influences us greatly in the treatment. If consciousness is retained at the same level, we are inclined to wait longer before decompressing (even if the pulse is slow but regular and respirations are quite slow but not varying in depth) than we would be in an unconscious patient with the same degree of slowing of the pulse and respiration. A steadily increasing state of consciousness we feel to be a good omen, even if some of the other findings are not so encouraging; whereas, a deepening state of unconsciousness causes us considerable alarm and demands urgently relief of pressure. The classical picture of an immediate loss of consciousness, followed by a clear interval, which is in turn followed by a second loss of consciousness, calls for an immediate operation which nearly always discloses an extradural hemorrhage. To recapitulate, a persistent deep coma means serious intracranial damage and grave prognosis (66 per cent. mortality in our cases), retention of consciousness is quite favorable, a returning consciousness even in the presence of unfavorable symptoms is most encouraging, but a deepening coma is indicative that the case is progressing unfavorably and measures for relief of pressure should be instituted.

Temperature.—Of the 223 patients, 82 had a normal or plus normal temperature on admission, and in this group there was a 26.6 per cent. mortality. One hundred and thirty-eight patients had a subnormal temperature on admission, with a mortality of 45 per cent. Patients presenting a subnormal temperature on admission are those with the most severe injuries and associated shock for which reasons the mortality is especially high. In the individual case the temperature on admission means little, unless it is extremely high or unduly low, in either event offering a poor prognosis. On the other hand, the course that the temperature takes later on does have a definite meaning. Cases with a steadily mounting temperature reaching 104°–106° rarely recover, for this is associated so often with deep coma, Cheyne-Stokes respiration, cyanosis and weak, rapid pulse, and with them

means that the stage of cerebral decompensation has been reached. In cases in which the temperature remains subnormal the danger from shock is of paramount importance. In favorable cases the temperature rises promptly after shock is recovered from, but does not usually go higher than 102°, it then falls by recessions of a degree or so a day. The onset of meningitis is usually indicated by a sudden rise of several degrees. Brain abscess is usually associated with normal or subnormal temperature. We do not believe a decompression advisable in a patient whose temperature is 102° and steadily mounting. Wilensky [7] has called attention to the prevalence of fever in skull fractures and attempts to explain it in one of three ways: (1) The upset of the heat centre, (2) meningitis, or (3) the escape of cerebrospinal fluid through tears in the pia which in the presence of a bacteriæmia gives a temporary mild meningitis. Courtney [8] states that the temperature stands supreme in scale of importance among the valuable prognostic and diagnostic signs. He feels that contusions of the brain are associated with a temperature around 102° and if the case is progressing favorably it falls gradually, but if unfavorably, it mounts steadily; lacerations of the brain give an immediate upward trend with infrequent and slight recessions. Nichols [9] states that the temperature is low in simple œdema but high with lacerations of the brain. Phelps [6] feels that with a primary temperature of 102°, or a subsequent one of 105°, there are no recoveries.

The Pulse.—Much information of value may be derived from the pulse. On admission the pulse has significance only if it is very slow, 30–40, or very fast, 120–160. Rates between these convey little of immediate prognostic or diagnostic value. It is what happens to the pulse later that is of significance. Our records show 84 cases admitted with a pulse of 90 or over, with a mortality of 39 per cent.; 85 cases with a pulse of 70–90, with a mortality of 31 per cent., and 54 with a pulse of 70 or below with a mortality of 37 per cent. A steadily diminishing pulse-rate means a steadily increasing intracranial pressure and indicates that the pressure must immediately be relieved. In addition to the actual slowing of the pulse, one notes a slight irregularity in rate first—thus, if one holds the pulse a full minute or two, he will count it 50 for one-quarter and perhaps 90 the next. When this is noted we feel that unless urgent steps are taken for the relief of pressure, the case will soon pass over into that stage where therapy will be of no avail. When a pulse that is steadily rising goes over 120 we feel that operative interference is not indicated. On the other hand, a slowly increasing pulse-rate that does not go over 90 or 100 is a good omen. One too often sees a pulse going from 50 per minute to 140 in a very short space of time, and if this occurs the prognosis is absolutely bad. The most important features of the pulse in skull fractures are: (1) that a steadily slowing rate or the same slow rate, associated with a slight irregularity, calls for relief of pressure; (2) a weak, rapid pulse is of poor prognosis and contra-indicates operation. No definite lower limit to the pulse-rate can be set when operation is indicated, but one must consider the other aspects of the case in

conjunction with the pulse. A case with a consistent pulse of 50 or below usually comes to operation. A comparison of both radial pulses was not done regularly, so we are not prepared to comment on the difference in the pulses on the two sides as noted by Phelps,[6] and which he ascribes to an interference with the correlation of the sympathetic and central nervous systems.

Blood-pressure.—Unfortunately, our observations on this phenomenon are not accurate or sufficient enough to justify any report. From the literature it would seem that the blood-pressure changes are not consistent enough to be of much value as a sign on which prognosis may be based.

Respiration.—Number of cases with respiration over 12, 192 with 33 per cent. mortality. Number of cases with respiration 12 or less, 16, with 43 per cent. mortality. Number of cases with respiration, Cheyne-Stokes, 59, with 80 per cent. mortality.

(NOTE: Deaths overlap in these cases, *i.e.*, one death may be counted under two headings.)

If when one first sees a case it presents Cheyne-Stokes respiration, the prognosis is usually bad, or if this type of respiration is allowed to appear in the course of the disease the hope of recovery is slight. We are particularly careful to pay the closest attention to the respiration and feel that (1) a steadily slowing respiration means increasing pressure; (2) frank Cheyne-Stokes respiration combined with rapid, weak pulse and coma, contra-indicate operation; (3) slight early irregularity in depth of respiration is most important as a positive sign of impending decompensation. It is necessary to watch the respirations for several minutes with a good view of the chest and abdomen in order to appreciate the first appearance of irregularity. We have noted in several cases a peculiar sigh interspersed at intervals in otherwise regular respiration and have come to regard this as a particularly ill omen.

Bleeding.—Number of patients bleeding from nose or mouth, 59, mortality 44 per cent. Number of patients bleeding from ear, 84, mortality 50 per cent. Number of patients not bleeding, 80, mortality 12.5 per cent.

Phelps [4] states that of 285 of his cases that bled from the ear, 119 died, and of 90 that bled from nose or mouth, 51 died. Crandon and Wilson [5] report 395 cases with bleeding from ear, nose or mouth with 181 deaths; they advise against irrigation of ears or nose. Ransohoff [3] emphasizes the seriousness of bleeding from the nose as in 19 of such cases only 4 recovered. Bleeding from the ears, nose or mouth mean usually more extensive injury to the base of the skull and a resultingly high mortality. At this point we would like to emphasize the importance of caring properly for a bleeding ear or nose. Negligence in this precaution is sure to lead to a certain number of cases of meningitis. Cleanliness and avoidance of introducing fluid into the ear or nose are the essentials. We are in the habit of cleansing the external ear or nares with gauze moistened in hydrogen peroxide (not irritating), and applying a large sterile dressing to the ear. This is changed as often as necessary. Under this régime we have had only 2 cases of meningitis which

is a bit lower than one finds in other series published. Thus, Mixter [2] reports 8 cases in a series of 301; Wilensky [10] 4 in 75, LeCount [11] 39 in 504, Phelps [4] 20 cases in 1000, Ransohoff [3] 4 in 190. We have seen brain substances in the external auditory canal in 3 cases, two of which promptly died and one recovered without operation, but was mentally deficient when last heard from. Phelps [4] reports 3 similar cases with the same result.

Examination of the Fundus.—This we have not found to be particularly useful as an aid in diagnosis, except in the later stages of the disease when one suspects pachymeningitis hemorrhagica or other causes of long-continued pressure. In the acute stages the fundi rarely, in our experience, give any information other than what one can glean from other sources. Kearney [12] reports constant findings of blurring of disc edges with some œdema, Wilensky [10] agrees with this, but other observers fail to corroborate; thus, Cohen [13] in 75 cases never saw a choked disc or doubts if it occurs, though he finds frequently a fulness of the vessels and slight blurring of the disc edges, Jackson [14] does not feel that the fundi show much change early and does not rely on them.

Pupils.—Cases with pupil dilated on the side of the lesion, 48; mortality, 52 per cent. Cases with pupil dilated on the opposite side of the lesion, 20; mortality, 95 per cent. Cases with no pupillary change, 155; mortality, 23 per cent.

The pupillary changes we feel are rather good indications of the amount of intracranial damage. An extreme amount is associated often with fixed dilated pupils and here the mortality is extremely high, in our series 100 per cent. This seems universally true, thus, Cohen [13] calls attention to the poor prognosis associated with fixed dilated pupils, Nichols [9] advises against operation when they are present, Crandon and Wilson [5] show 131 deaths in 142 cases, Ransohoff [3] 42 cases with 41 deaths. The dilated pupil is most often on the side of the injury, for there the damage is severe, so much so, as to cause 52 per cent. mortality in our series; when, however, the pupil on the opposite side is dilated, we are inclined to feel that the contre-coup damage is more severe than that on the side of the injury and that the sum total of the injury is such that an extremely poor prognosis is offered. When a pupil which was large on admission comes down to normal size, the prognosis is apt to be favorable; but when a pupil which was equal to its mate on admission later becomes dilated, we feel that the intracranial damage is progressing and becomes suspicious of an extra or intradural hemorrhage. Walton [15] feels that the pupillary changes are due to injury to the cilio-spinal tract. Phelps [16] states that a single dilated pupil was found in 11 out of 30 cases of extradural hemorrhage, both pupils were dilated in 7 cases, normal in 3, and contracted in 5; and quotes Hutchinson as saying that a single dilated pupil meant an extradural hemorrhage in the middle fossa on the same side. Crandon and Wilson [5] show that in 155 cases with unequal pupils 90 died; Holman [17] emphasizes the value of unilateral dilatation as a localizing sign and cautions as to its transitory character.

Convulsions.—Cases presenting focal convulsions, 7. Cases presenting general convulsions, 2. Mortality, 66 per cent.

Convulsive seizures ordinarily mean extensive cortical damage rather than extradural hemorrhage, for in the latter case one more frequently finds paralysis than an irritation. When a focal convulsion is repeated two or three times over an interval of an hour or so, we are in the habit of operating as much for the possibility of correcting damage which may later lead to epilepsy as for immediate results. We do not believe that one focal attack, particularly in children, calls for operative interference, as we have two cases which recovered spontaneously.

Paralysis.—In our opinion a definite, persistent, paralysis or weakness of an extremity in a patient with a skull fracture is an absolute indication for operation. A hæmiplegia, if one can rule out an apoplectic stroke and coincident skull fracture, is an urgent indication for operation, for it is so frequently associated with extradural hemorrhage. Facial paralysis is most often due to injury to the nerve in the canal and scarcely falls in the same category as paralysis of an extremity. In our series 25 patients presented evidence of paralysis with a mortality of 48 per cent. We have not encountered a case of longitudinal sinus syndrome as described by Holmes and Sargent.

Reflexes.—Not many cases in this series show changes in the reflexes. About all one learns of value as to the reflexes is that absent reflexes are of very grave prognosis; and that any real change in the reflexes means more damage within the cranium and therefore a more serious prognosis than if the reflexes were unchanged. Our records show normal reflexes in 183 cases with a mortality of 28.4 per cent., absent in 17 with 100 per cent. mortality, increased on the side of the lesion in 10 with 50 per cent. mortality, and increased on the side opposite the lesion in 13 with a mortality of 46 per cent. The impression gained from the literature is that changes in reflexes are apt to be transitory and are of little value both in prognosis and as an indication for operative interference.

Spinal Puncture.—Reports as to the use of lumbar puncture in the treatment of fractures of the skull begin to appear in the literature about 1905. From that time until about 1922 most of its advocates were among the French and Italians. Jackson,[14] in 1922, strongly advocated its use and seems to have stimulated interest in it as a diagnostic and therapeutic agent. Until four years ago we had been fearful of performing spinal puncture on patients with skull fractures on account of the supposed danger of medullary paralysis. We have been using it as a routine measure in the series of cases herewith presented and now feel that not only is it not dangerous, but is frequently of real value either therapeutically or from a diagnostic viewpoint. One hundred and seventy-eight of our patients had one or more lumbar punctures, and of this number only one showed ill effects attributable to the puncture. This occurred in a patient who later was found to have a large extradural hemorrhage. The ill effects manifested were a focal convulsion becoming generalized, weak, rapid pulse, irregular respiration and coma. He rallied, however,

and was later operated on. More will be said later of the use of lumbar puncture in extradural hemorrhage. In doing a puncture one should proceed cautiously, allowing the fluid to escape very slowly and having the patient quiet before making a reading of the pressure. Our readings are made with a vertical manometer graduated in centimetres of water, taking 5–10 cm. as normal. We do not feel that any reading is absolutely correct in that it gives the exact amount of intracranial pressure, but that one can arrive at fairly definite conclusions even though there is some degree of error. In our opinion spinal puncture cannot be used alone as a means of relieving intracranial pressure in every case, but must be combined with a decompression in the higher degrees of sustained pressure. It seems of undoubted value as a means of lowering the intracranial tension and I feel sure that due to its use we are doing fewer decompressions than formerly. We are in the habit of performing punctures as frequently as indicated and withdraw the fluid until the pressure is normal. Not all cases admitted with skull fractures receive punctures; those who are only mildly affected by their injuries and show no evidence of pressure by sign or symptoms are not punctured for fear of producing a meningitis; patients with marked bleeding from the ear, especially if cerebrospinal fluid escapes at the same time, are not punctured, unless it is urgently required, for the same reason cases with obvious extradural hemorrhage are never punctured. Viewed from the standpoint of spinal puncture one can arbitrarily group cases as follows:

1. Cases with definite evidence of skull fracture but a normal pressure, and no alarming symptoms. Here the fluid is pinkish or clear. One puncture suffices. If the pressure is normal, no fluid is withdrawn.

2. Cases with evidence of increased intracranial tension of severe or moderate degree, and on whom puncture shows a high pressure (20–30 cm.). Following one or more punctures, the signs of pressure diminish and succeeding punctures show a falling pressure. The fluid here is apt to be quite bloody. Punctures are done at intervals until the pressure is normal or the signs no longer are alarming. It is in this class that the puncture finds its greatest therapeutic usefulness and obviates many decompressive operations.

3. Cases with marked evidence of intracranial tension and a high pressure on the initial puncture. Subsequent punctures show either no drop in pressure or a rising pressure. Here the puncture is of little value therapeutically, as it accomplishes no lasting reduction in the tension, but it is of much value as an indication for some other means of relief of pressure. This is the class of case we treat by decompression.

4. Cases with evidence of high intracranial tension and high initial spinal fluid pressure, but in which subsequent taps reveal a low pressure and examination shows no diminution in the severity of the symptoms. Here the symptoms seem to be due to the injury to the brain itself rather than to pressure upon it. Decompression seems of no avail, for when the dura is exposed no undue tension is found; and the patient succumbs.

5. Cases with marked evidence of pressure with the spinal fluid *clear*,

of small amount, and under high pressure. In these we strongly suspect an extradural hemorrhage, and are disinclined to withdraw any fluid. If subsequent examinations show localizing signs or signs of increasing pressure, we decompress rather than take the risk of a spinal tap.

Our views on spinal punctures are summarized as follows:

1. It is not dangerous if properly used.

2. As a therapeutic measure it is of value in selected cases.

3. It may be used to advantage as an indicator of the intracranial pressure and on this, subsequent therapy may be directed.

4. With clear fluid under high pressure we strongly suspect an extradural hemorrhage.

Holbrook [18] uses lumbar puncture as a diagnostic means of determining early increased intracranial pressure and as a therapeutic measure. Fay [19] states its use to be dangerous. Grant [20] uses it as does Jackson.[14] Sachs [21] is opposed to its use, having seen two deaths attributable to it. Wilensky [10] in 1919, says lumbar puncture is of no value clinically or therapeutically and in 1921 [22] states that "lumbar puncture has not given complete satisfaction as a therapeutic measure." Nichols [9] says "high pressure of spinal fluid, as shown by manometer readings, is of greater value than high blood-pressure as an indication for operation." Ransohoff,[3] in 1910, predicted that lumbar punctures would be used more widely in fractures of the base.

A summary of our experience with lumbar puncture may be given as follows:

Number of patients receiving punctures on admission 178, a mortality of 40 per cent.
Number of patients not punctured on admission 45, with a mortality of 20 per cent.
Bloody fluid obtained in 168 cases, with a mortality of 44.3 per cent.
Clear fluid obtained in 12 cases, with a mortality of 8.3 per cent.
Character of fluid not reported 2 cases; mortality 0 per cent.
Initial pressure of fluid 1–10 cm., 18; mortality 4.4 per cent.
Initial pressure of fluid 1–20 cm., 59; mortality 18.6 per cent.
Initial pressure of fluid 20–30 cm., 49; mortality 46 per cent.
Initial pressure of fluid 30–40 cm., 41; mortality 63.4 per cent.
Not recorded, 11.

Amount of Fluid Withdrawn on Initial Puncture

1–10 c.c., 14 cases; mortality 57.1 per cent.
10–30 c.c., 83 cases; mortality 32 per cent.
30–50 c.c., 46 cases; mortality 50 per cent.
50–70 c.c., 15 cases; mortality 20 per cent.
75–100 c.c., 5 cases; mortality 66.6 per cent.
Not recorded, 15 cases; mortality 0 per cent.
Cases with increasing pressure, 26; died 14.
Cases with decreasing pressure, 29; died 7.

Apparently bloody fluid is associated with a higher grade of intracranial damage and a necessarily higher mortality. It is interesting to speculate as to why pressure as low as 1–10 cm. should be associated with such a high mortality as 44 per cent. This could conceivably be due to a filling of the foramen magnum by an œdematous brain stem or blood clot and a consequent

lack of free communication between intracranial and intraspinal chambers; to a leakage of cerebrospinal fluid through fracture lines, but most plausibly to serious damage to brain substance without increased intracranial pressure. Naturally the higher pressures are associated with a higher mortality. There seems to be no gross relation between the amount of fluid obtained and the mortality.

The field of usefulness of spinal puncture may well be extended to the post-operative period also. It has been of much help in this respect and we feel that several of our cases have survived after operation due to its employment. The pressure as shown by the bulging, and lack of pulsation of the hernia, is surely temporarily relieved following the puncture. If one assumes that some of the late effects of skull fracture, such as headache, photophobia, mental changes, etc., are due to a continued increased intracranial pressure, it would seem rational to continue the punctures during a patient's convalescence until the pressure is found to be normal. Only recently have we insisted on this, and it will be instructive to follow these cases comparing them as far as possible with those on whom it was not done.

We have frequently been struck by the large amount of fluid one obtains on spinal puncture in some cases of skull fracture. In six of our cases 75–100 c.c. were withdrawn on the initial puncture, in 15 cases 50–75 c.c., in 46 cases 30–50 c.c. Subsequent punctures continue to yield large amounts until within 24 hours one may withdraw as much as 600 c.c. of fluid. Whether this is an increased production, a decreased absorption or not true cerebrospinal fluid, we have as yet found no good method of determining.

Extradural Hemorrhage.—Of our 223 we have only 9 cases of proven extradural hemorrhage, one of which was disclosed at autopsy in a patient who was not operated upon. Six recovered and three died. Moody [23] reports 100 cases of extradural hemorrhage in 908 cases of skull fracture, and states that 63 were not diagnosed clinically; that 37 cases were subjected to operation and of these 26 died. Phelps [16] reports 34 cases found in a series of 200 fractures of the skull. One should always be on the alert for this type of case for an early diagnosis and operation give the patient his only chance. The history is most important if obtainable, a hemiplegia is strongly suggestive, and a clear fluid under high pressure should serve to put one on his guard. Many observers lay great stress on a single dilated pupil as a valuable sign of extradural hemorrhage and we have found this to be quite true. Peairs [24] emphasizes the point that extradural hemorrhage is often accompanied by irritative phenoma rather than by paralysis—this has not been true in our series, in which we have seen paralysis in nearly every instance.

Operations.—Operations on the skull for one cause or another have been done for centuries and the procedure of trephining is among the oldest of surgical operations. The first trephinings for fracture of the skull were done on account of the fracture and without regard to the pressure effects

upon or injury to the brain itself. This mistaken idea that the fracture was responsible for the signs and symptoms was held until about 1800, since when most observers mention at the beginning of their writings that "it is not the fracture which needs attention, but its effects upon the brain."

The rationale of this procedure seemed to be (1) that a great many of the cases developed abscesses beneath the skull at the site of the fracture, and the early trephining was therefore a prophylactic measure; and (2) that extradural hemorrhages could be evacuated. More than one opening was made if found necessary, the openings being made at the site of fracture. It was considered very dangerous to open the dura, and this was rarely done. Later the opening of the dura was advised if it bulged through the bone defect, but the opening was closed if possible, thus obviating the decompressive effects of the procedure. Warren [25] in fracture of the base advised draining the subdural space with a gauze wick through a trephine opening. Finally, Cushing in 1908 devised the present subtemporal decompression.

Ever since operations for skull fractures have been described there has been much discussion regarding their value. Apparently the profession has formed itself into three groups, one advising operation in nearly all cases, another advising against operation, and a third believing in operation for selected cases. At different periods each of these groups has held the field; at present the pendulum seems to have swung towards conservatism, operations being rarely performed and only when other measures for the relief of pressure (lumbar puncture, hypertonic salt, etc.) have failed.

The subtemporal decompression as described by Cushing is used in this Clinic, the cranial defect being made well down toward the base of the skull. We are in the habit of closing the temporal muscle but not the temporal fascia, as we feel this allows more room for the bulging brain. Fine black silk is used throughout the closure. A rubber tissue drain is inserted down to the base, to act as a continuous avenue of escape for the cerobrospinal fluid. It is removed in forty-eight hours. Since using spinal puncture as a post-operative measure, we have only resorted to a bilateral decompression once. The simple *depressed fractures* are operated on immediately, simple elevation through a trephine hole adjacent to the depression being the method of choice. Many of these fractures cannot be elevated as simply as this, and it becomes necessary to rongeur away portions of the depressed fragments in order to effect a satisfactory elevation. If the dura is uninjured it is not opened; if lacerated, it is opened more widely, the cortex examined, and the dura closed. If there are signs of pressure, a sub-temporal decompression is combined with the elevation. The *compound fractures* are handled by a meticulous débridement of the soft tissues, removal of loose bone fragments, débridement of the lacerated cortex and suture of the pia if possible. If there is much loss of dura so that its closure is impractical, a transplant of fascia lata is done from the thigh. The wound is closed completely without drainage. All cases have healed per primam save one in which a superficial skin

infection developed. The operation is combined with a subtemporal decompression if necessary. This type of case so often decompresses itself through the open wound that one rarely sees the manifestations of increased intracranial pressure associated with them. The extensive osteoplastic flap operation such as one uses for exploratory craniotomies is to our minds not the operation of choice in these acute cases; for it is time consuming and many of the patients do not tolerate loss of blood or prolonged anæsthesia. Frequently we have encountered depressed fractures in old patients who have injuries to the chest and these are easily operated on under local anæsthesia. The cases which were subjected to operation were the most serious ones in the series. Fifty-six cases were operated on as follows:

1. Débridement of extensive scalp wounds in cases with linear fractures and no pressure symptoms, 3 cases with no mortality.

2. Elevation of depressed fractures, 11 cases with 9 per cent. mortality.

3. Elevation of depressed fractures combined with subtemporal decompression, 7 cases with 28.5 per cent. mortality.

4. Subtemporal decompressions in 35 cases of basilar fracture with 45.7 per cent. mortality.

There were two infections in the series, both in compound fracture, but both superficial and of no real consequence.

Mortality.—The total mortality for the entire series which includes all cases of skull fracture, irrespective of other associated injuries, length of time they survived, etc., is 35.8 per cent. Phelps [4] reports a general mortality of 46.8 per cent. in 793 cases, Besley [26] 53 per cent. in 1000 cases, Harris and Nissen [27] 51.3 per cent. in 330 cases, Brown [28] 29.8 per cent. in 100 cases, Wilensky [10] 31 per cent. in 75 cases. The analysis of the deaths shows that 14 died in 1 hour or less after admission, 24 died in 1–3 hours, 5 died in from 3–6 hours, 9 died in 6–12 hours, 5 died in 12 hours–1 day, 11 died in 1–2 days, 7 from 2–4 days, 5 from 4–7 days. Four cases died of pneumonia, one from cardiac dilatation. Thus we find that of the 80 deaths 52 occurred in the first 12 hours. These 52 represent that group of cases referred to previously as those who rapidly die in spite of all therapeutic measures. This leaves 171 cases grouped under "those that rapidly recover" and "those whose outcome is problematical." In these two groups the mortality is 16.3 per cent. In 22 of the 80 deaths there were other severe associated injuries, such as stove-in chests, and compound fractures of other bones.

Complications.—Of the early complications following skull fracture only three are found in our series, *i.e.*, one case of meningitis; one of persistent facial palsy, and one slight wound infection following operation for compound depressed fracture of the vault. We have not seen sinus thrombosis, arteriovenous aneurism, mastoiditis, brain abscess, aerocele, or other complications.

Treatment.—Our comments on the treatment of skull fracture scattered through the preceding paragraphs may be summarized as follows:

1. Depressed fractures or compound fractures, and cases suspected of extradural hemorrhage are operated on immediately.

2. All simple fractures except those with very mild symptoms are subjected to lumbar punctures and are carefully observed for variations in pulse, respiration, temperature, state of consciousness and neurological signs. If, in spite of the lumbar punctures the pressure is found to be increasing or to remain high, a subtemporal decompression is performed at an early date. Those cases which respond to lumbar puncture are treated by that means.

3. The punctures are done until the pressure is found to be normal and to remain so.

The most important phase of the treatment is the period of observation when one views the changing train of events, weighs the importance of each, and directs his therapy accordingly.

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PARTIAL NEURECTOMY OF THE SENSORY ROOT OF THE GASSERIAN GANGLION IN TRIFACIAL NEURALGIA WITH PRESERVATION OF CORNEAL SENSATION

By Adrian S. Taylor, M.D.

of Peking, China

From the Department of Surgery of the Peking Union Medical College

The modern operation for the relief of major trifacial neuralgia has undergone several stages in its development. The first procedure suggested was to avulse the ganglion itself. This was followed by the avulsion of the posterior root, next it was cut without avulsion, and later it was found to be possible to divide the sensory fibres alone, preserving the motor root to the muscles of mastication. In the early cases a large percentage of the patients showed a post-operative keratitis, and many eyes were lost. Since the section of the posterior root as suggested by Spiller [1] in 1901, replaced avulsion either of the ganglion or of the root itself, the incidence of keratitis has fallen, yet Frazier [3] estimates that it occurs in greater or less degree during immediate convalescence in 10 per cent. of all patients subjected to complete sensory root neurotomy, and he feels that in a certain additional percentage, corneal complications develop after the patients leave the hospital. Among the explanations offered for this serious complication are the frequent traumata to an insensitive cornea, the drying of the eye following loss of function of the lachrymal gland, "trophic" changes after injury to the ganglion or to the ophthalmic nerve, and the loss of the protection afforded by the upper lid in those occasional unexplained cases of paralysis of the seventh nerve, and in the disturbance of the little understood sympathetic innervation. Verhoeff [4] has recently discussed fully the causes of post-operative keratitis and lays stress upon the effect of drying of the cornea. The explanation of the loss of lachrymal function is not clear, as the question of its nerve supply is still unsettled. Verhoeff is inclined to believe that it receives a double supply from the ophthalmic division of the fifth and from the large superficial petrosal branch of the seventh. The innervation from the fifth is of course lost in all complete post-ganglion neurectomies, and from the seventh in complete paralysis of that nerve or of the large petrosal which is easily injured as it passes close to the ganglion.

The problem of preserving the cornea has been an especially acute one in the Peking Clinic, because of the fact that many of the patients are poor and are unable to carry out the directions given for the care of the eye after one of the radical operations. The climate of north China is exceedingly dry and cold, for many months of the year high winds are prevalent and the atmosphere is filled with dust. The importance of the preservation of corneal sensation was emphasized by the loss of an eye in a Chinese patient admitted to the ophthalmological service with paralysis of the entire fifth nerve from

a basal luetic process. This patient was first seen subsequent to the onset of anæsthesia over the whole of the trigeminal area, but before corneal ulceration had occurred. Within two weeks the eye was lost notwithstanding hospital care by the eye service. Two European patients soon afterwards came under observation with "epidemic" or infectious ganglionitis and both showed partial anæsthesia of the cornea with corneal herpes. Fortunately both recovered without serious scarring of the cornea.

In the discussion of this problem, the suggestion came from A. H. Woods, in charge of neurology in Peking, that an attempt be made in suitable cases to divide partially the posterior root, severing only those fibres supplying the second and third divisions of the nerve, conserving at least a part of the bundle of fibres which make up the first division. He called attention to the fact that in every large nerve the component fasciculi occupy definite positions in the nerve trunk, and pointed out that the fibres in the posterior root of the trigeminal supplying each main division of the nerve always lie in fixed positions, those fibres supplying the first division being found above and medially, those to the second branch next, and those to the third lowest and most lateral. The possibility of identifying and preserving the motor root has been recognized for a number of years.

The procedure suggested by Woods was carried out by the writer in three cases in Peking before return to America recently on furlough, when Frazier's [2, 3] communications were first seen. In his last [3] he reports twenty-five cases of subtotal neurectomy done during the past ten years with complete relief and without recurrence of the neuralgia or corneal complication in any instance. Frazier discusses the anatomical and physiological basis for the operation, and in a personal communication he mentions unpublished work in the embryology of the nerve which shows that the first division develops as a separate nerve. The results in subtotal division of the posterior root of the ganglion indicate that the function of the ophthalmic division may be retained after permanent destruction of the second and third branches.

The technic employed in the cases of trifacial neuralgia in Peking does not differ from the standardized operation. Thorough exposure in a dry field must be secured and Adson's lighted retractor has been found helpful. The middle meningeal artery is controlled by plugging the foramen spinosum with pledgets of cotton and bone wax before the artery is divided. The distal end of the artery is ligated with fine silk. A reliable clip would greatly simplify matters at this point, but the instruments available in Peking are unsatisfactory, and a new instrument is being devised to carry a short strip of a narrow silver ribbon like a miniature skin clip instead of the usual short piece of round wire which has such a discouraging tendency to slip and roll and fall off at inopportune moments. After thorough exposure of the sensory root is obtained, a short right-angled blunt hook is passed from below upward and inward beneath the fibres running through the ganglion to the third division. These are elevated, the motor root beneath identified and preserved and the fibres held by the hook are sharply divided with a short right-angled

knife blade. Adson's guillotine would be useful here. Those fibres going to the second division are then visualized, lifted up and divided. To make sure of the complete division of all posterior fibres to the second branch, the section is carried just into the fasciculi running to the ophthalmic nerve.

As the neuralgia in the three patients operated upon was most pronounced in the maxillary nerve, the second division itself was cut distal to the ganglion in order to assure division of all of the fibres going into it. The peripheral end was avulsed, and the foramen rotundum was plugged with silver foil as an added precaution against regeneration. The third branch was not disturbed distal to the ganglion, but in all cases anæsthesia was complete over its distribution. The possibility of central branch fibres remaining undivided with the danger of recurrence of the neuralgia or of its extension into the previously uninvolved first branch is recognized, but the risk appeared justifiable because of the greater hazard to an insensitive eye. Frazier's report shows that one may be sure of the complete division of the second branch centrally, thus making unnecessary its section distal to the ganglion. In any type of operation, trauma to the ganglion should be avoided, and the first branch should never be cut distally as connection between cornea and its undisturbed ganglionic cells through untraumatized nerve fibres is held to be important in preventing "trophic" change.

Sufficient time has not elapsed to justify a personal evaluation of the method, but Frazier's report justifies the hope that the relief afforded may be permanent.

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PERSISTENT AND RECURRENT HYPERTHYROIDISM

By Frank H. Lahey, M.D.

and

Howard M. Clute, M.D.

of Boston, Mass.

Forty-eight cases of persistent or recurrent primary hyperthyroidism have required secondary or repeated operations in the Lahey Clinic to remove their thyroid toxæmia. Of this group of 48 cases, 29 had been previously operated upon in this Clinic and 19 had had their primary operative procedures elsewhere.

Of the 48 cases that have had secondary thyroidectomies, the records are incomplete in 24. This is due to the fact that 19 of these cases were previously seen in other clinics and the remaining five cases have incomplete records of their early treatment. In these 24 cases, certain facts can be ascertained from such data as we possess. The average time elapsing between their first operation and their visit to the Clinic was four years. The longest interval between operations was ten years and the shortest period, one year. It is not known whether these patients were toxic during this interval or whether their disease was quiescent.

Before their second admission these 24 patients had had 32 operations performed on the thyroid gland. These operations were performed as many as ten or more years ago in some cases, and were undoubtedly of a different character than the procedure followed at the present time. In certain cases pole ligation, combined with hot water injections, had been performed. When part of the thyroid gland was removed, a much greater proportion was undoubtedly left behind at that time than is now deemed advisable. In many cases a hemithyroidectomy alone was performed.

The average metabolic rate of this group of 24 cases on admission for further treatment was +58 per cent. Their subsequent treatment consisted primarily in the further removal of thyroid tissue such as hemithyroidectomy or subtotal thyroidectomy.

On discharge from the Clinic the average metabolic rate of this group was 28 per cent. Thirteen of the 24 cases had a normal rate within six months after discharge, 9 have not been heard from and 2 are still definitely toxic.

The average age of this group at the time of their first operation was thirty-seven; the youngest being twenty-one and the oldest being fifty-five.

No positive conclusions can be drawn from this group. We have the impression that in the majority of these cases their original toxicity while possibly improved was not cured by their first operation. They doubtless had been suffering from thyroid toxicity during the entire interval preceding

their secondary operations. In no cases did we fail to find a good-sized piece of hyperplastic thyroid gland in the neck.

There now remain 24 cases of primary hyperthyroidism who have returned for secondary operation in whom our records are for the most part complete from the first of their illness to the present time. Study of this group of patients shows that they fall readily into two main divisions. In the first class are 19 patients whose metabolism never came to normal after their first series of operations, although clinically they were improved by their operative treatment. In the second group are five patients who were clinically cured after their first series of operations and left the hospital with a normal metabolic rate to come back later with a return of symptoms and high rate. The patients in the first group may be said to have had persistent hyperthyroidism and those in the second group recurrent hyperthyroidism.

The average metabolic rate of the 19 patients having persistent hyperthyroidism was 75 per cent. at their original admission to the Clinic. Several of this group were as seriously ill as any thyrotoxic patients we have treated. All were treated by multiple stage operations.

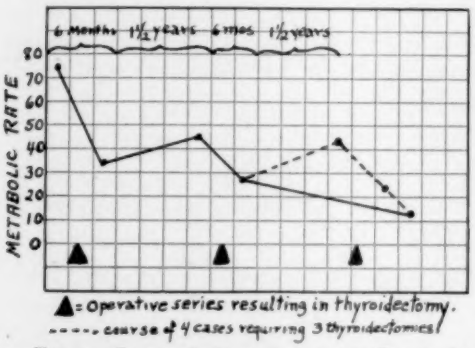

FIG. 1.—Course of the average metabolic rate in nineteen cases of "persistent" hyperthyroidism. Note that the rate never came to normal until after the second or third sub-total thyroidectomy. In the four cases shown with the dotted lines, a third thyroidectomy was done. The average rate for the group at discharge was + 14.

After the first operative series the average rate for the group was 34 per cent. Check up metabolisms were done after each operative series in all these patients whenever possible, as is our custom in treating all cases of hyperthyroidism, and attempts were made to reoperate those cases having a persistent high metabolic rate. The average interval between the first and second operative series in this group was one and one-half years. When these patients were admitted for their second operative series their average metabolic rate was +45 per cent. After this second series was completed the rate on discharge averaged for the group 28 per cent.

In 4 cases in this group of persistent hyperthyroidism patients a third subtotal thyroidectomy was performed. The average rate for the group before their third operation was +42 per cent. On discharge this had dropped to +25 per cent. For the entire group the last metabolism estimation available, which in nearly every case is several months after the final operation, averages +14 per cent. Two patients are still slightly toxic, showing both by clinical signs and an increased metabolic rate that they are not yet cured. One of these has had two subtotal thyroidectomies and the other three subtotal thyroidectomies. The average age of the 19 patients in this group having persistent hyperthyroidism at the time of their first operation was thirty-two. The youngest was sixteen and the oldest fifty.

Lugol's solution has been used repeatedly in this group of patients during the past two years. In many cases the metabolic rate has dropped to normal after its use. Persistence in following up the patient, however, has demonstrated that this was not a permanent drop in rate. In no case of hyperthyroidism persisting after thyroidectomy, that we have followed, has Lugol's maintained the metabolic rate at normal. Our experience with these patients demonstrates very clearly that failure of the rate to return to normal within two or three months after operation is always due to the presence of too much hyperplastic thyroid tissue in the neck. We still believe that it is worth while to administer Lugol's solution to these patients in the hope that some one may be permanently benefited. We are certain, however, that patients with high metabolic rates after thyroidectomy must be warned of the probable necessity of further operative removal of thyroid tissue unless the rate reaches and remains normal in eight to twelve months.

In the final group of patients we have five women who were apparently cured of their thyroidism but suffered a recurrence of the disease. The average metabolic rate for this group of patients on their first admission to the Clinic was +68. After the first series of operative measures they were discharged from further treatment with a metabolic rate averaging +5. The highest rate of the group on discharge being +14 and the lowest being +4. An interval then occurred in which these patients were definitely free from symptoms. The average length of this period was two years. In three cases it was three years and in one case only a few months passed before the rate again began to increase and the patient showed evidence of returning toxicity. The average metabolic rate before the second series of operations in this group was +45 per cent., which fell after operation to +9 per cent.

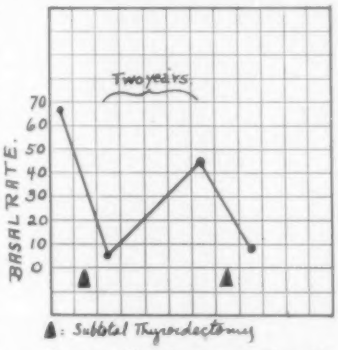

FIG. 2.—Showing course of metabolic rate, in group of five cases of "recurrent" hyperthyroidism. Apparent cure six months to a year after first subtotal thyroidectomy. Return of high rate and symptoms of thyroid toxicity after two year interval. Second apparent cure by thyroidectomy.

The average age of these five patients at the time of their first operation was thirty-one, the oldest was thirty-nine and the youngest was twenty-two.

Four of these five patients took large amounts of Lugol's solution over a period of weeks or months. In each patient some temporary clinical improvement was obtained, but in no case did the metabolic rate remain normal or the clinical evidence of thyroid toxicity permanently disappear.

In these 48 cases of recurrent or persistent hyperthyroidism we have never failed to find a good-sized piece of thyroid tissue in the neck at the second operation. We have a distinct impression that the tendency of the occasional thyroid operator is to leave too much thyroid rather than to remove too much.

In four patients in the series there occurred, clinically, a very definite

hypertrophy of the small remnants of thyroid tissue left at the first operation. At the secondary operations in these cases new lobes as large, or even larger than the original ones, were found. One of these had received large amounts of iodine medication, but this did not prevent the recurrence of large pieces of thyroid on two occasions. This woman has had three subtotal thyroidectomies, her metabolic rate is still elevated, she is clinically still toxic, and a definite enlargement of the left lobe is once more becoming evident.

It is frequently very difficult to palpate any thyroid tissue in the neck upon which a previous thyroidectomy has been performed. We have repeatedly been surprised at the size of the thyroid remnant in cases where none could be palpated. We are convinced that in the presence of a persistently increased metabolic rate and clinical evidence of persistent or recurrent thyroid toxicity, reoperation should be advised. The fact that no large piece

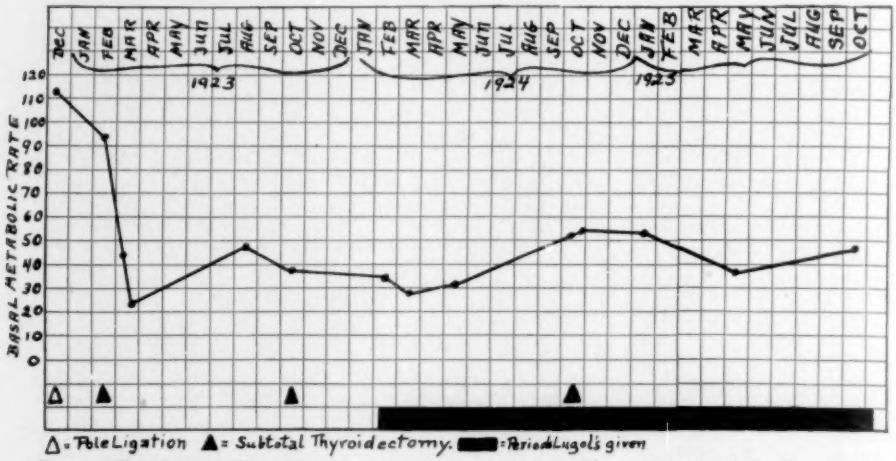

FIG. 3.—Female aged fifty. Severely toxic primary hyperthyroidism. At each of the three subtotal thyroidectomies, large pieces of thyroid tissue have been removed. Note that long-continued use of Lugol's solution has neither lowered the metabolic rate nor prevented recurrence of hyperplasia of the thyroid remnants. Patient still toxic when last seen and a large hyperplastic lobe can again be felt on the left side of the neck.

of thyroid tissue can be felt through the scar of the previous operation is no evidence that a large segment of thyroid is not still present and overfunctioning.

There have been no deaths in this group of 48 patients. There have been no hemorrhages. No case of tetany has occurred, and, insofar as we know, there has been no post-operative paralysis of the recurrent laryngeal nerves.

The reoperation upon patients upon whom a previous inadequate subtotal thyroidectomy has been done is a much more difficult and trying procedure by far than subtotal thyroidectomy upon a thyroid upon which no previous operative procedures have been carried out. Bleeding is profuse and of the oozing type, the prethyroid muscles are adherent to the gland, the great vessels are likewise adherent to the gland and anatomical relations are greatly disturbed. Due to these factors, to the profuse bleeding and to the trying difficulties of the procedure, unless definite and logical steps are at one's

command, small and again inadequate amounts of thyroid tissue will be removed and the thyroidism will persist.

In our experience with these 48 cases of recurrent or persisting thyroidism we have gradually devised a technic which permits of exposure of the entire persisting segment of thyroid tissue on either side of the neck. With this method it is just as possible as in an original subtotal thyroidectomy in a case of primary hyperthyroidism, to observe the entire segment, to mark off with hæmostats the part to be left behind and to excise that portion which is to be removed by the same technic as was described by one of us in *Surgery, Gynæcology and Obstetrics* for June, 1923.

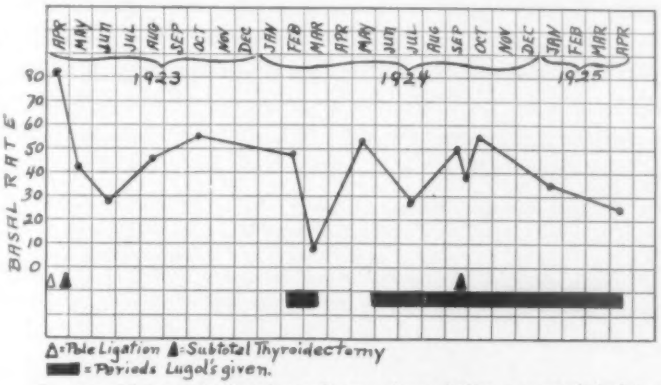

FIG. 4.—Male aged thirty-four. Course of metabolism over period of two years in severe case of persistent primary hyperthyroidism. Note, in February, 1923, the use of Lugol's solution caused rate to drop. Rate then returned to old level when iodine was stopped. Later administration failed to cause a permanent lowering of metabolic rate. At second operation a large piece of thyroid tissue was found in the neck.

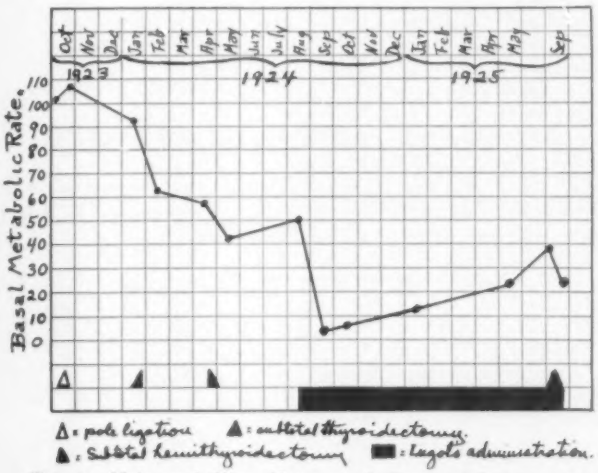

FIG. 5.—Male aged fifty. Note, metabolic rate failed to reach normal after two hemithyroidectomies. With use of Lugol's solution, rate came to normal and symptoms of toxicity though still present were improved for a time. In eight months, patient was clinically very toxic and his metabolic rate was again elevated to +40. A second thyroidectomy was done on this patient with the removal of a very large piece of hyperplastic thyroid tissue and marked clinical improvement. No marked metabolic rate change has yet occurred since this operation.

Although firm adhesions are present in these cases between the prethyroid muscles and the cut and roughed surface of the gland, they may be readily cut away with scissors, since no structures will be endangered in the procedure provided the scissors dissection be not carried out to the region of the internal jugular vein. After this dissection the muscles may be freed and cut between clamps just as in the original operation. The cut muscles being retracted upward and downward, the segment of thyroid then comes into view.

Close inspection of the thyroid remnant will now show that it is bound

firmly in its bed by numerous adhesions. The anterior adhesions having been cut in the detachment of the anterior muscles, those remaining will be between the outer surface of the gland and the internal jugular vein and the sternomastoid muscle. It is by dealing with these adhesions satisfactorily that we have been able to expose and remove or leave behind any proportion of the persisting thyroid tissue, no matter how numerous or dense the adhesions that we dissect. The entire success of adequate reoperation upon remnants of thyroid glands is dependent upon complete freeing of the internal jugular vein and common carotid artery from the thyroid remnant and wide retraction of those vessels outward.

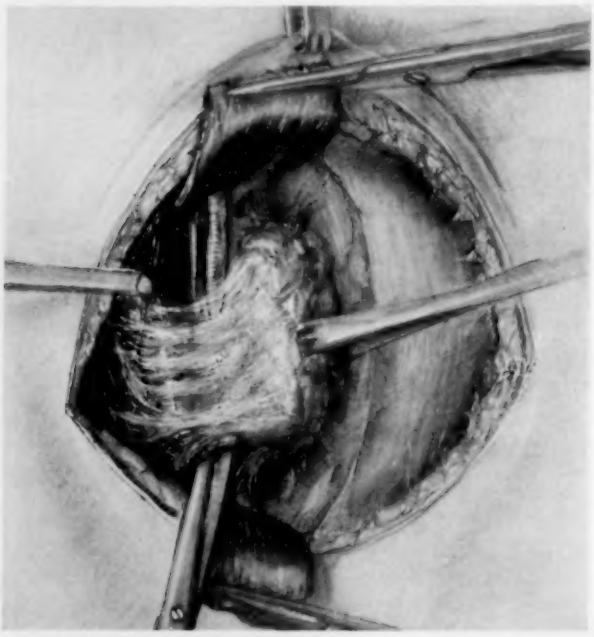

FIG. 6.—Exposure of residual thyroid tissue in secondary thyroidectomy. Note adhesions to internal jugular vein. These must be separated completely to permit full exposure of the thyroid remnant.

This having been accomplished, a double hook may be introduced into the remnant, it may be elevated from its bed and as much removed and as much left behind as one desires. Fortunately adhesions do not exist on the posterior surface of the gland, and when the large vessels are freed, no difficulty is experienced in elevating the remnant.

The dissection of the internal jugular is best begun above the stump of remaining thyroid tissue, the vessel being identified and followed down to where it becomes adherent to the thyroid remnant. By gentle dissection with blunt scissors it may be quite rapidly separated from the gland with remarkably little bleeding. In the entire 48 cases we have had no trouble with the internal jugular and it has not required ligation in any case.

The parathyroids and recurrent laryngeal nerves are protected by leaving behind a thin strip of thyroid tissue as in an original subtotal thyroidectomy.

In no cases with the aid of this technic, have we failed to fully expose the thyroid remnants regardless of the previous operative procedures. Several of the cases, as has already been stated, had had injections of boiling water, previous to the original subtotal thyroidectomy which preceded our operations upon the remnants, and in one case the neck had been so deeply burned by X-ray that skin, prethyroid muscles and thyroid gland were replaced almost completely by firm fibrous tissue, persisting and overfunctioning islands of thyroid tissue, however, still resulting in an intense hyperthyroidism.

CONCLUSIONS

Following subtotal thyroidectomy, persistence of symptoms of hyperthyroidism, together with persistence of a basal metabolic rate above normal, indicates that there still remains a segment of hyperfunctioning gland capable of producing hyperthyroidism.

Removal of a very large proportion of this segment by reoperation will in a majority of instances bring about a cure.

The administration of Lugol's solution to these cases, even over a period of months, has failed to produce a single cure.

The essential factor in the reoperation of these cases is the separation and retraction of the internal jugular vein and the common carotid artery from the thyroid remnant. With this done, any amount of thyroid tissue desired may be removed from the thyroid remnant.

OSTEOMYELITIS OF THE STERNUM

By Abraham O. Wilensky, M.D.

and

Saul S. Samuels, M.D.

of New York, N. Y.

From the Mount Sinai Hospital of New York and the Brownsville and East New York Hospital of Brooklyn

In a previous communication by one of us (Wilensky) the mechanism of acute infection of bone—osteomyelitis—was extensively discussed. The present paper concerns itself with osteomyelitis of the sternum, a rather uncommon form of this disease. The principles of the mechanism of osteomyelitis in general, as previously described, will be incorporated in this communication as it applies to osteomyelitis of the sternum; and the phenomena and extraordinary features of pyogenic infection of the latter bone will be found to be entirely explainable on the essential mechanism described.

The last comprehensive report on osteomyelitis of the sternum is one by Drews and appeared in 1910. Drews was able to collect only 12 cases from the literature up to that time, and reported an additional case from Muller's Clinic. A more thorough search, however, has since brought to light 5 more cases reported prior to 1910 and 2 cases reported since last year, making with the 3 we shall describe, a total of 23 cases reported to date.

Henschen, in Von Bergman and Brun's system, estimates the relative occurrence of osteomyelitis of the sternum as one-third of one per cent. of all forms of osteomyelitis. In the last ten years there have been treated at the Mount Sinai Hospital, 578 cases of osteomyelitis of all kinds and varieties. Among these there were only two cases of osteomyelitis of the sternum; the percentage relation is the same as the estimation of Henschen. At the Brownsville and East New York Hospital, there has been admitted in the last four years 54 cases of osteomyelitis. Among these there has been only one case of osteomyelitis of the sternum; the percentage relation is 1.8 per cent., which is considerably higher and is explainable on the relative shortness of the time interval and the smaller number of cases in the series. The important fact to be noted is that the sternum is one of the bones of the body which is least apt to be involved as a secondary and subsidiary focus in general infections and one in which a thrombo-embolic lesion is least apt to develop into a fixation point.

Henschen estimates the mortality of osteomyelitis of the sternum as 50 per cent. Of the 11 cases we shall note, besides the 13 of Drew's, 3 died and 8 recovered, giving a mortality of 27 per cent.

CASE REPORTS

Case I.—Male; twenty-four years old. Five months before admission to the hospital, the patient had had a bilateral pneumonia. On the tenth day of the pneumonia, a nodule appeared over the upper part of the sternum which soon opened spontaneously and dis-

charged pus. The resulting wound, at approximately the junction of the manubrium and the gladiolus, has been discharging ever since. At the radical operation a partial and local resection of the sternum was done (Doctor Wilensky). The skin around the sinus was excised, and a piece of the gladiolus through which the sinus ran was resected. The sinus went right through the bone. The posterior periosteum and anterior mediastinum was intact. The wound was sutured with a small drain at one end and this was followed by primary union. After healing of the wound, an X-ray picture showed a defect at the junction of the manubrium and the gladiolus. The Wassermann reaction was negative.

Case II.—Female; thirty-five years old. Five years previously the patient had had typhoid (?) fever. Two years previously an abscess of the thigh was incised and the resulting wound continued to discharge until one month before the present admission to the hospital. Six weeks before the present admission to the hospital, the patient developed a "cold" with pain in the chest. At this time she noticed a lump over the sternum which progressively increased in size. There was no malaise or fever.

It was demonstrated at operation that a large abscess was present over the upper end of the sternum which contained several ounces of pus. On exposing the bone a sinus was found at the right border of the sternum between the first and second ribs, which admitted a fine probe for one-half inch. The abscess cavity was emptied and the sinus was thoroughly curetted. Healing followed. Doctor Moschcowitz operated upon this patient; we are indebted to him for permission to use these notes.

The Widal reaction was negative. The Wassermann reaction was negative. The pus from the abscess contained paratyphoid bacilli B, but agglutination tests with B. typhosus and paratyphoid A and B bacilli were negative in dilutions of 1 to 50 to 1 to 6000. Duodenal contents contained no paratyphoid bacilli. The urine and stools contained no typhoid or paratyphoid bacilli. No tubercle bacilli were found in the pus.

Case III.—Male, twenty-four years old. Four years before the present admission to the hospital the patient was struck over the sternum while playing football. There was some tenderness over the sternum but no other symptoms and the tenderness subsequently disappeared. Six months later the patient began to have pain over the sternum and an abscess developed which was incised and drained. There have been numerous recurrences of this abscess formation in the last eighteen months.

At the time of admission to the hospital a funnel-shaped sinus was present over the middle of the sternum at approximately its junction with the third costal cartilage. Surrounding this there was an area of inflammation occupying about one-half of the chest wall; an abscess was present.

The abscess was first incised and drained; bare bone was felt at the bottom of the abscess. Two weeks later the radical operation was done (Doctor Wilensky). A sinus was found extending through the sternum into the anterior mediastinum. The second and third costal cartilages were involved in the inflammatory focus. The entire extent of the sternum which was involved in the focus was excised and with it the entire second and third costal cartilages. There was considerable scarring of the posterior periosteum of the sternum, and of the connective tissues of the anterior mediastinum. A brisk hemorrhage from the internal mammary artery was controlled by suture. The resulting wound was packed wide open. Healing took place slowly.

Case IV.—Six days before admission to the hospital, the patient—a child of eight years was struck in the chest by the elbow of a playmate. On the next day pain was felt in the region of the sternum. Three days later the pain was more severe and the temperature had risen to 103° F.; on the next day the temperature had reached 106° F. and the child became delirious.

At the time of admission, there was a red, tender area over the sternum at the level of the fifth rib. There was some question as to the presence of a pneumonia on the right side; the röntgenographic examination of the lungs was, however, negative. There were 12,000 white blood cells to the cubic millimetre with a differential polymorphonuclear count of 86 per cent. On the second day after admission the general condition of the child

grew rapidly worse. A cultivation of the peripheral blood showed 300 colonies of staphylococcus aureus to the cubic centimetre of blood.

Doctor Klingenstein operated upon this patient. A focus was demonstrated to be present in the body of the sternum at the level of the third rib, which reached over and involved the costo-sternal articulation. There was no perforation into the pleura although the anterior mediastinum was involved.

The child died soon after the operation. There was no post-mortem examination.

CASES FROM THE LITERATURE

CASE V.—Drews' case was in a young adult. The entire manubrium was found lying unattached in the middle of an abscess cavity. There were no blood culture studies; but the pus contained staphylococcus aureus. The patient recovered.

Drews' report contains the following cases from the literature previous to 1910.

CASE VI.—Solomon's case also occurred in a young adult; there was a fatal issue. There were coincident involvement of the right sterno-clavicular joint and pulmonary symptoms. The post-mortem examination showed involvement of the manubrium and the gladiolus to about its middle; a retrosternal abscess in the anterior mediastinum; a right sterno-clavicular suppurative arthritis. No blood culture study was made; but, from the character of the clinical course, a bacteriæmia must have been present.

Sick's cases included the following:

CASE VII.—A nine-year-old boy had an osteomyelitis limited to the body of the sternum between the second and fifth ribs; a perforation was present into the mediastinum. There was a fatal issue. The post-mortem examination showed multiple foci in the femur, radius and lungs. No blood culture studies were reported; undoubtedly, however, a bacteriæmia must have been present at some time.

CASE VIII.—A sixteen-year-old boy had an acute osteomyelitis of the entire body of the sternum with fatal issue. The post-mortem examination showed in addition a fibrinous pericarditis, a bilateral hemorrhagic pleuritis, a liver abscess, and a purulent peritonitis. The manubrium was intact. This is a typical example of a general infection. It is difficult to make out from the published report whether the pericarditis and pleuritis were due to direct extension of the infection by contiguity of tissue or by perforation, or whether they represented metastatic foci. There are no blood culture studies on record.

CASE IX.—A fifteen-year-old girl had an osteomyelitis of the body of the sternum with a subperiosteal abscess. A recovery was made.

CASE X.—A twenty-one-year-old man had an osteomyelitis of the upper part of the body of the sternum with a subperiosteal abscess. There was a secondary focus in the right wrist-joint. A recovery followed.

Neither of the last two cases had blood culture or other bacteriological studies.

CASE XI.—von Tungel's case was referred to by von Bergman: An eighteen-year-old man died five days after the onset of a severe acute general infection. No localizing foci were discovered during life. The post-mortem examination showed multiple hemorrhages in the heart muscle; several bone foci in the femur and acromion and a focus in the lower end of the sternum. No blood culture studies were reported.

CASE XII.—Jochman's case was in a seventeen-year-old boy. The patient died two days after the onset of a fulminant acute general infection. A focus was present involving the sternum and the contiguous portion of one of the ribs; an abscess had developed which had broken through into the anterior mediastinum. No blood culture or other bacteriological studies were reported.

CASE XIII.—Muhlein's case was in a twenty-two-year-old man. An abscess developed in the synchondrosis between the manubrium and the gladiolus. The post-mortem examination showed in addition a lung abscess and a splenic tumor.

CASE XIV.—Korte's case was in a young girl of eighteen years in whom at the post-mortem examination it was demonstrated that a purulent mediastinitis had complicated

an osteomyelitis of the manubrium and gladiolus; a pericarditis was also present. In spite of the fact that there were manifestations of a severe general infection, it seems more probable that the mediastinitis and pericarditis had occurred by direct extension of the focus. No blood culture or other bacteriological studies were reported.

CASE XV.—Albertin's case occurred in a young adult and followed typhus fever. Four other cases developed rib foci after typhus fever. There are insufficient data in the report.

CASE XVI.—von Thiem's case was a twenty-six-year-old woman. The lesion followed the severe exertion of threshing grain. There are insufficient data in the report.

CASE XVII.—Batut's case was a twenty-two-year-old sailor. Three months after typhoid, he noticed a swelling over the sternum at the level of the third and fourth ribs; this was incised and the sternum was curetted; healing followed. Two months later the swelling reappeared and numerous fistulæ formed; these were curetted. New fistulæ appeared near the xiphoid two weeks later which extended to the sternum. The condition was treated conservatively. A more radical operation was contemplated but the patient objected and disappeared from observation. No bacteriological studies were reported.

CASE XVIII.—Vaughn's case was a twenty-six-year-old man. There was no history of trauma and a gradual onset with pain in the chest over the upper part of the sternum. Four days after the onset of symptoms a swelling appeared in the latter location. The swelling was explored on the sixth day: the upper middle portion of the sternum was found to be involved in an osteomyelitic focus; the periosteum was thickened but stripped easily. The anterior cortex and medulla was cleared out as far as the posterior cortex. The anterior mediastinum was not involved. The wound was packed wide open; healing took place and a recovery followed. The sterno-clavicular and sternochondral joints were not involved.

CASE XIX.—Peloquin, Peradon and Vogelin report a case which occurred seventeen months after an attack of paratyphoid fever. Persistent sinuses formed which led to the sternum. Four operative revisions were necessary. Vaccines were used. Finally the patient succumbed to a pleuro-pneumonia. The sputum contained paratyphoid bacilli and streptococci.

CASE XX.—Merchant's case in a forty-one-year-old man. There was a sudden onset with pain in the chest, chill and fever. A general infection was present. A localization occurred over the sternum and seven days after the onset an incision was made over the bone. There was complete involvement of the sternum down to the xiphoid with complete separation of the first and second portions of the gladiolus. On inserting a finger behind the sternum, respiratory movements were felt. Secondary fracture occurred and was due to bone necrosis. Death occurred after sixteen days.

The post-mortem examination showed the following: (1) Right encapsulated empyema; (2) small left pleural effusion; (3) subcutaneous abscesses over the sternum; (4) congestion of the lungs; (5) sequestration of the sternum; (6) suppurative chondro-sternal arthritides; (7) dense adhesions of posterior periosteum to pericardium and mediastinal pleural (no perforation).

CASE XXI.—In Bidwell's case a swelling appeared over the sterno-clavicular joint two weeks before admission which contained pus. This was followed by dyspnœa and a depression formed at the site of the sternal swelling: on the next day there was a discharge of pus from the aspiration opening and the child died four days later. The autopsy showed a pus sac the size of a walnut overlying the upper part of the breast bone; on opening the sac the upper part of the gladiolus and the lower part of the manubrium were found to be absent. The cavity communicated with the left sterno-clavicular joint and with the anterior mediastinum. The umbilical vein was filled with pus. A liver abscess was present also.

CASE XXII.—Koch's case was a thirty-year-old man. There was a sudden onset with epigastric pains and high fever. A diagnosis of pneumonia was made. After nine days the pain localized to the sternum and a fluctuating mass soon appeared over the

ensiform process. This was incised. Two days later another abscess formed near the right breast, which was also incised. From both of these, fistulæ developed. Five weeks after the onset, a radical operation was done. The sternum from the second to the sixth ribs were completely riddled with abscesses, to which the fistulæ extended. The pericardium and the mediastinum were exposed after the removal of the necrosed sternum, and were found to be covered with granulations. The pus contained staphylococci. No blood cultures were reported. The patient recovered.

Case XXIII.—Janz's case was in a twenty-one-year-old soldier. There was a sudden onset with fever, chill and pain in the chest. A diagnosis of pneumonia was made. Three days later a tender swelling appeared over the sternum. One week after the onset an incision was made over the sternum. After going through the skin, a large amount of pus escaped from the depths at the level of the second and third ribs. The periosteum was thickened. The corpus sterni was intact, but there was a separation of the corpus and the manubrium. There was a large cavity behind the sternum in the anterior mediastinum about the size of a fist. The pericardium was visible at the bottom of the cavity. The pericardium, pleura and lungs were not involved. The sterno-chondral and sterno-clavicular joints were not involved.

Case XXIV.—Busch's case was in an eighteen-year-old girl. A purulent anterior mediastinitis followed an osteomyelitis of the sternum (manubrium and corpus). Both sterno-clavicular joints were involved and they as well as the manubrium and corpus were resected. A pericarditis was also present.

One year after operation, the patient was presented as a completely recovered case with hardly any change in the shape of the thorax or interference with the stability of the shoulder girdle.

In previous communications the mechanism of bacterial infection in general, and of osteomyelitis in particular, were extensively discussed. As far as these observations apply to osteomyelitis of the sternum, it suffices to summarize them as follows:

The ordinary case of acute osteomyelitis results from a bacteriæmia or general blood infection, the origin of which is in the greatest number of cases obscure. In these cases it is thought that the entry point of the infection must necessarily be some surface (skin or alimentary canal) of the body; in actual practice it is assumed that, with very few exceptions (genito-urinary infections, furuncular infections of the skin, this surface is the mucous membrane lining of the alimentary canal at points where collections of lymph-adenoid tissue are especially prominent (tonsils, especially; Peyer's patches, etc.). At the latter areas a lesion need not necessarily be demonstrable. In a small minority the bacteriæmia or general blood infection accompanies or follows a definite entity such as a pneumonia or a definite focus of infection is present somewhere in the body—phlebitis, post-partum sepsis, a furunculosis, etc.,—to which the bacteriæmia or general blood infection is subsidiary and through which in turn the osteomyelitis originates. One of the cases reported by us here belongs in this latter group, the sternal lesion having followed a paratyphoid infection.

In any case the focus in the sternum is a fixation point to which the bacteria circulating in the blood are attracted; commonly only a single one of these fixation points develops in the sternum. When the number of subsidiary foci which develop following the original bacteriæmia or general blood infection is more than one, some of the fixation points may be located

in other tissues and structures, as for instance, in another bone or joint. Examples of these are to be found among the cases reported herewith. The possibility of any of these subsidiary lesions in turn, forming a point of distribution from which a bacteriæmia of general blood infection may occur and from which subsidiary foci can develop in exactly the same way, were fully discussed on several other occasions by one of us.

The bacteriæmia through which joint infections become established and develop are not always demonstrable. It is well known that these states may be of temporary duration; that they occur during apparent health as well as during disease; that the natural forces of the body are usually amply sufficient to overcome these so promptly that no evidence of their presence is perceptible in any way; and that in exceptional cases, when these protective factors break down, the presence of bacteria in the blood, even for these short periods, is sufficient to infect any locality. While in extraordinary circumstances it may be possible for bacteria to pass through a surface of the body (tonsils, for instance) and multiply in the blood, the available knowledge seems to show that ordinarily bacteria circulating in the blood depend for their existence there primarily upon the presence of an infected thrombus. Then the course of events is one of two: (1) Microscopic pieces of the thrombus carrying a number of living organisms break off and circulate through the blood stream, or isolated organisms growing on the surface of the thrombus, or groups of them in the forms of bacterial emboli, are cast off into the blood stream. In the small minority of these instances in which the natural antibodies are not sufficient to destroy the organisms as fast as they are discharged into the circulation, the infected thrombus-embolus becomes caught into the capillary network of the sternum, and becomes a fixation point and furnishes the initial stage of a focus of osteomyelitis. (2) In addition to the preceding the virulence of the bacteria may be sufficient to enable them to multiply in the blood stream.

The physical characteristics of the infected thrombus-embolus formation (fixation point), the consequent disturbances of the local circulation and its resultant effects on the tissues of the sternum have direct effects on the clinical and pathological anatomical picture.

A fixation point is formed by the arresting or location of a thrombus-embolus at some point of the vascular network of the sternum. The actual point depends more on chance than on anything else, and is decided by the physics of the local bone circulation at the given moment. Various pathological pictures result, depending on the size of the plugged vessel, the relative position of the plug, the powers of vascular anastomosis, etc., in conjunction with the character, virulence, etc., of the bacteria giving rise to the infection. The dominant characteristics of the pathological pictures are: (1) A thromboarteritis or thrombophlebitis; and (2) a necrosis of bone and cartilage cells consequent to the disturbance of circulation. The physical characteristics of the pathological picture depend to the largest extent upon the second factor.

In actual disease the position of fixation points are probably determined

by some kind of local trauma at the given point. This has been extensively referred to on several previous occasions. I include under the general term of trauma all varieties—mechanical and physical trauma, chemical trauma, etc. In clinical experience the cases group themselves into (*a*) those in which there is a distinct history of a definite physical trauma, and (*b*) those in which no such history is elicitable.

The physical basis for the predisposing effect of trauma consists in the tearing of some of the vessels and in a consequent gross or microscopic hæmatoma associated with blocking and slowing of the local circulation at one or more points, this is a fixation point in the sense that any living organisms floating in the circulation can and may be arrested at the point blocked and develop there. Trauma was an important factor in one of the cases reported in this paper.

The sternum—including its three divisions—is composed of delicate cancellous tissue, covered by a thin layer of compact tissue, the latter being thickest in the manubrium between the articular facets for the clavicles. Although preformed in cartilage, the finished structure approximates that of bones which are developed in membrane. Because of this the physical characteristics of the circulation in the sternum is an important factor in the occurrence of foci of infection within the bone.

The blood supply of the sternum does not originate from any single vessel. Numerous vessels derived, form muscular and other branches in the muscles and tissues attached to the sternum or derived from larger trunks nearby—the internal mammary vessels—perforate the three divisions of the sternum and supply it with blood. The vascular network within the sternum resembles that of other flat bones and is of the periosteal type. The extensive anastomosing network in the periosteum of the sternum sends down short branches into the cancellous tissue of the sternum which resemble in their structure and distribution the Sharpey's fibres of the long bones. Apparently there are no end vessels such as one finds towards the avascular areas of the long bones.

Because of these circumstances thrombo-embolic formations occur as one of two manifestations. In the one kind the focus develops between the periosteal membrane and the external compact layer of the sternum. Subperiosteal abscesses result and are quite common; they are illustrated in the cases quoted or reported in this communication. The periosteum of the sternum is very firm and strong and the path of least resistance for the purulent collection is between it and the underlying bone; so that quite frequently the progressive accumulations of pus causes a dissection of the sternal segments from their ensheathing periosteum. This is seen frequently clinically and is illustrated in some of the cases reported herewith in which it is described that one or other of the sternal divisions was found free in a large abscess. As in the bones of the skull the dissection is limited at the synchondroses; any further accumulation results in perforations, in front, into the subcutaneous tissue, and, behind, into the thorax. The segment of

bone lying free in the abscess is deprived of its nourishment by such dissections and necroses.

When the subperiosteal abscesses occur on the anterior aspect of the sternum they have little or no clinical importance. Those occurring on the posterior aspect are important factors in the production of complications peculiar to osteomyelitis of the sternum because of its anatomical position: these complications form determining factors in the extraordinary mortality accompanying acute osteomyelitis of the breast bone.

The chief of these complications are mediastinal, intrapleural and intrapericardial suppurations. Some of these are due to frank perforations of a retrosternal subperiosteal abscess; others are sympathetic processes called forth by the presence of infectious processes in the sternum and its periosteum and are produced by bacterial progression through the lymphatics either into the lymphatic network of the mediastinum or into the lymphatic spaces of the pleural and pericardial sacs. Both varieties are usually accompanied by the clinical signs of a profound infection and are frequently unrecognized either before operation or before their post-mortem demonstration. Except in those cases in which the osteomyelitic foci in the sternum are accompanied by states of bacteriæmia or general blood infection, practically the entire mortality is due to these complications within the interior of the thorax.

In the second variety the focus of infection develops in the cancellous substance of the sternum. A peculiar form of creeping, molecular destruction of the bony texture results which is very difficult to control except by resection of the sternum in healthy tissue. The physical basis for this advancing process was referred to in another communication; this consists in a continual progression of the thrombus-embolus formation in the focus of infection in the cancellous tissue of the sternum because of the extension of the area of venous thrombosis; from the facts at hand and previously referred to this seems to be due to the unchecked bacterial growth in the clotted area.

STATISTICS

Age.—The ages of the patients included in this report are the following:

4 weeks old	1 case	22 years old	2 cases
9 years old	1 case	24 years old	2 cases
15 years old	1 case	26 years old	2 cases
16 years old	1 case	30 years old	2 cases
17 years old	1 case	35 years old	1 case
18 years old	4 cases	41 years old	1 case
21 years old	3 cases	(Age not noted in one case)	

Two-thirds of the cases occurred in patients between the fifteenth and twenty-sixth years. This must have some relation to the period of time in which the various ossification centres are at their maximum activity. Coincident with the full ossification of the sternum and thereafter, the number of cases of osteomyelitis of the sternum decrease rapidly.

Sex.—There were eighteen male patients in this series as opposed to six females. The sex is not noted in one reported case.

Position of Focus.—The distribution of the osteomyelitic process in the sternum was as follows: Manubrium, six times; gladiolus, thirteen times; ensiform process, two times; synchondroses, two times.

In a number of the cases more than one segment of the sternum was involved in the focus of infection. In one case all these segments were involved. The much more frequent involvement of the gladiolus is most probably related to the anatomical peculiarities of the local vascular network and to the arrangement of the various centres of ossification.

Complications.—The most important phenomena of osteomyelitis of the sternum are formed by the characters and numbers of the complicating lesions which are met during the course of the illness. As indicated previously, some of these are due to the anatomical position of the sternum and to the fact that the organs, tissues or spaces in which these complicating foci of infection develop are in direct anatomical relationship with the sternum. The others, in spite of their close anatomical relationship to the sternum, are, undoubtedly, metastatic (subsidiary, secondary) foci of infection in the true sense of the word as previously defined.

In this series of cases the following were the complications which were encountered:

Pneumonia	10 cases	7 died
Pleurisy and pulmonary congestion	1 case	1 died
Pulmonary abscess	3 cases	3 died
Pulmonary and renal infarct	1 case	1 died
Retrosternal abscess	2 cases	
Anterior mediastinitis	10 cases	4 died
Pericarditis	2 cases	1 died
Chondro-sternal involvement	1 case	1 died
Sterno-clavicular joint involvement	3 cases	2 died
Peritonitis	1 case	1 died
Liver abscess	2 cases	2 died
Renal abscess	1 case	1 died
Splenic abscess	1 case	1 died
Prostatic abscess	1 case	

In many of the cases these complicating lesions did not exist as isolated foci but existed in combination with other foci. Under these circumstances, the fatalities which occurred could not be directly imputed to any one of the lesions, but, rather, to a state of infection in which the entire organism partook, and in which the demonstrable foci were, perhaps, incidental factors and could be regarded as expressions of the general infection.

Retrosternal Abscess and Anterior Mediastinitis.—Retrosternal abscess and anterior mediastinitis formed the most common complication encountered. It was difficult sometimes to make the distinction between retrosternal abscess and anterior mediastinitis from the published records of the cases and in some of them, at least, the distinction would disappear in that the inflammatory area could be classified under either or both of these terms. Four of the ten cases classified as anterior mediastinitis died. Some of these were recognized only at the post-mortem examination, and it is possible, had

efficient drainage been instituted at an early period of the disease, that the fatality would have been averted. As indicated previously in this report, both retrosternal abscess and anterior mediastinitis find their origins in the formation of a subperiosteal abscess on the posterior surface of the sternum.

Pneumonia.—Pneumonia formed the next most important complication of osteomyelitis of the sternum. The lesion described is that of a frank consolidation. It is a debatable point whether this lesion was metastatic to the sternal focus of infection, whether it was brought about by a relative immobility of the chest owing to the presence of a focus of infection in the sternum, or whether both of these contributed equally to the pulmonary consolidations. It seems difficult to make an adequate distinction. Pneumonia is apparently a very grave complication; in this series two-thirds of the patients with this complication died.

Pleurisy and Pulmonary Congestion.—The two cases of pleurisy and pulmonary congestion most probably belong with the cases of pneumonia. Both of the patients with this complication died.

Pericarditis.—There were three cases of pericarditis; two of these died. One of the latter was evidently a case of general infection in which the pericarditis was only one of a number of lesions. In the other, there were coincident mediastinitis and pericarditis and the assumption seems justified that the pericarditis occurred by direct extension of the inflammatory area.

These are the more important complications. All of the others listed in the classification are due to the presence of a general infection in which they form metastatic or subsidiary foci. In one of the cases with liver abscess the umbilical vein was found to contain purulent material.

Differential Diagnosis.—The differential diagnosis of osteomyelitis of the sternum is apparently sometimes difficult. The differentiation between osteomyelitis of the sternum and that of the adjacent cartilages or ribs can, on occasion, be an academic one; fortunately in actual practice this is not of much importance. The diagnosis of pneumonia has been made a number of times and the presence of the sternal focus was not recognized until comparatively late, or only at the time of the post-mortem examination. The difficulty can be quite well understood in the extraordinary frequency with which the two conditions coexist. Other conditions—an eroding aneurism, a tumor of the sternum, tuberculosis or syphilis—are conditions to be thought of; these, however, should be easily excluded.

An interesting condition has been described by Ruediger and later by Narat, which the latter calls "xiphoiditis." This should not be confused with true osteomyelitis of the sternum. Xiphoiditis is not an osteomyelitis but, apparently, an isolated perichondritis of the ensiform process, giving rise to tenderness and pain over the xiphoid and to pain in the epigastrium. Narat removed the xiphoid in five cases and microscopic examination showed evidence of chronic periostitis. The pain disappeared spontaneously in some cases; in others it disappeared after the exhibition of salicylates.

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THE SURGERY OF GASTRIC AND DUODENAL ULCERS

EXPERIENCES OF THE FIRST SURGICAL CLINIC UNIVERSITY OF BUDAPEST
(DIRECTOR PROF. T. DE VEREBELY)

By Geza de Takats, M.D.
of Chicago, Ill.
FORMER ASSOCIATE IN SURGERY, UNIVERSITY OF BUDAPEST

One of the questions that interests all medical circles to-day, is the treatment of gastric and duodenal ulcers. Purely medical treatment on the one side, conservative or radical surgery on the other, are constantly discussed subjects. All agree on certain absolute indications of surgical interference, such as mechanical obstruction of the pylorus, acute hemorrhage, and perforation. A divergence of opinion is present, however, in the management of chronic callous ulcers. Putting the stomach at rest and controlling the acidity are the objects of medical treatment. Doctor Sippy's important work has shown how many ulcers can be healed this way. Protein-therapy has also given promising results in the hands of some investigators. If no absolute indication exists, we give our patients a medical management for six weeks. If symptoms persist, or if symptoms recur after returning to ordinary life, operation is indicated.

There has been much said and written in the last few years about the surgical treatment of gastric and duodenal ulcers, and the work of Haberer, Finsterer, Kelling, A. A. Berg and Alfred Strauss in favor of the radical procedure against other statistics and especially those of the Mayo Clinic for the more conservative treatment are well known. To these I desire to add an experience based on the material of the first surgical clinic of the University of Budapest, from the year 1914 to 1924. (Table I.) These

Table I

Gastric Operations of the First Surgical Clinic, University of Budapest. 1914–1924.

Ulcers gastric and duodenal	841
Carcinomas	401
Sarcoma	1
Fibromyoma	2
Total	1245

Gastrostomies, furthermore, operations for perforations and hemorrhage are not included in this series.

statistics include 1245 gastric operations for ulcer and carcinoma: gastrostomies and operations for perforated ulcer and for acute hemorrhage are not included in this series. Of the 841 ulcer cases 676 could be traced after the operation and followed up. Table II needs some detailed explanation. The late results were divided into three groups, good, fair and poor,

TABLE II

676 Operations for Ulcers

Operation	Number of cases	Mortality	Late results Good	Fair	Poor
Pyloric exclusion, v. Eiselsberg	85	3.5%	60%	10%	30%
Excision, cuneiform, longitudinal and sleeve resection	41	3.7%	65%	15%	20%
Gastro-entero-anastomosis	274	5.8%	50%	22%	28%
Radical resection *	226	5.4%	84%	10%	6%
Secondary resection for recurrence	20	7.3%	81%	14%	5%
For jejunal ulcers	21				
First 200 anastomoses: mortality		2.7%			
Last 74 anastomoses: mortality		7.7%			
Last 88 resections: mortality		3.3%			

* A distinction should be made between gastric and duodenal ulcers. Gastrectomy for the former is more generally accepted. However in order to gain a true basis of comparison for the merits of gastrectomy *versus* gastro-enterostomy, a uniformly radical indication has been adopted.

good meaning no complaints, fair occasional complaints and poor recurring of symptoms. As you see, the pyloric exclusion gave us 30 per cent. poor results, and in accordance with other data in the literature, this procedure predisposes the most to jejunal ulcers. We have abandoned this method completely.

The various types of excision whether cuneiform, longitudinal or circular have been abandoned because late results have not been satisfactory. We have not tried the Balfour cautery method plus anastomosis.

The unusually high mortality of anastomosis is due to the following fact: The first 200 operations were performed on all risks with a typical retrocolic posterior short loop; 2.7 per cent. was the mortality. In the last 74 cases the mortality was high (7.4 per cent.) because the anastomosis was only performed when resection was not possible, either because of anatomical conditions or because of the general bad state of the patient. On the other hand, the mortality of radical resections (5.4 per cent.) has been reduced to 3.3 per cent. by growing experience and perfection in technic in the last 88 cases. This percentage is only 0.6 per cent. higher than that of the routine anastomosis. Adding furthermore the great mortality of re-operations to that of the anastomosis, we find that the risk for the patient is by no means greater in gastrectomy.

Another observation which is in favor of radical procedures is the following: In examining histologically our resected gastric ulcers, in 25 per cent. atypical proliferations were found on the margin of typical callous ulcers. Macroscopically no expert pathologist can detect a beginning carcinoma developing on the basis of an ulcer.

No one can give an exact explanation for the good functional results after radical resections. The change in innervation and the lowering of acidity may be made responsible for the favorable functional results. In Table III

TABLE III

Lowering of Acidity

Number of cases	Type of operation	Before operation	After operation
200	Anastomosis	F. HCl., 24	F. HCl., 23
		T. A., 53	T. A., 46
200	Resection	F. HCl., 30	F. HCl., 3
		T. A., 56	T. A., 15

the lowering of acidity was determined in 200 anastomoses and the same amount of resections three weeks after the operation. It seems evident that technically well-performed resections practically do away with free hydrochloric acid. No pernicious anæmia or any other intestinal disturbance was noted. Time will show how these patients without pylorus, antrum and hydrochloric acid are going to fare in life.

Our always lessening mortality which decreased to 3.3 per cent. in the last 88 cases may be due to three factors:

1. *The Use of Local Anæsthesia.*—Every resection is started under local. After opening up the abdomen splanchnic anæsthesia is performed. In 85 per cent. of the cases no pain was felt during operation. In 15 per cent. ether by the drop method had to be added, however the quantity never exceeded 25 to 50 c.c., a very small dose in comparison with the long duration of the operation. In a good abdominal wall-block, the muscles are well relaxed and the general anæsthetic is only given for the intra-abdominal pain.

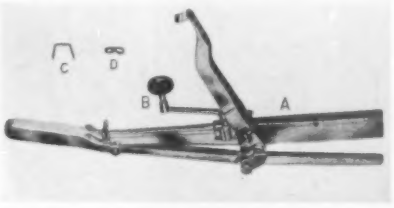

FIG. 1.—Hültl's wire-stitching instrument. A, represents the broad, square crushing clamp which harbors the four rows of staples C; B, shows crank; by turning the same to the right, after the clamp has been closed, the staples are driven through the tissues (wall of stomach or intestines) and their ends bent inward (D), having met the resistance of the other branch of the clamp beneath. The bent staples are gradually pushed off in the course of the healing and discharged through the rectum. They do no harm.

2. *The Use of an Intestinal Sewing Machine.* (Fig. 1.)* Both duodenal and gastric stumps are sewed with powerful crushing clamps that bury new silver clips in four rows and perform an aseptic and watertight closure in two to three minutes. A continuous row of serous sutures is made to bury these metal clip sutures. This procedure is not only absolutely aseptic but shortens the duration of the operation considerably. It is also as safe as any other suture and having used it for the last ten years in all our intestinal cases, we found no reason to suspect any failures due to this apparatus.

3. *The Third Factor* for the improvement in results is the constantly growing experience of our staff in this type of operation. It may seem superfluous to emphasize this fact: but there is a tendency in this country and elsewhere to look down upon technic as something of secondary importance. A good theoretical basis is extremely important for the surgeon. At the

* Described in this country in Ochsner's II volume of Surgery in an article of Dr. Willy Meyer. The above illustration is taken from that article.

University of Budapest nobody is admitted to the surgical staff so long as he has not had at least one year's work in the pathological institute. Yet let us not forget that all other factors being the same, a good and swift technic may mean the life of the patient. This is especially true in gastric surgery.

There is some modification in the technic employed in our gastrectomies. (Fig. 2.) The duodenum is closed blindly and so is the stomach in an extent to remove about two-thirds of the stomach. Instead of suturing a loop of jejunum in its whole length into the gastric stump like Polya does or closing the upper two-thirds like Finsterer, we close the whole stomach, amputate the resulting blind pouch at the lower end of the stump and suture a not too short loop transversally into the opening. The proximal loop is fixed with a few interrupted sutures to the blind end of the stomach so as to avoid regurgitation. This method has been devised because in Finsterer's technic, a blind pouch appeared soon after the operation under the X-ray, opposite the cardial opening and caused sometimes distress to the patient. In our technic, the anastomosis lies on the left side of the spinal column, the efferent loop being in a straight line with the œsophagus.

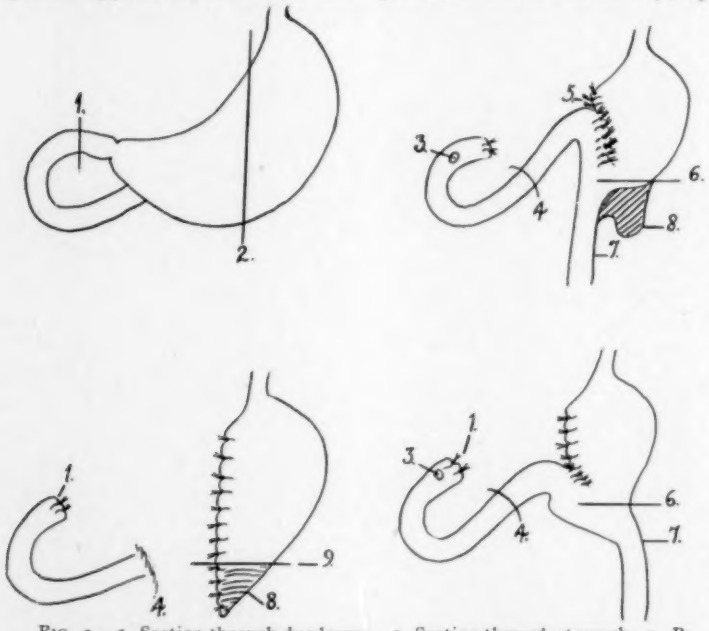

FIG. 2.—1. Section through duodenum. 2. Section through stomach. 3. Papilla of Vater. 4. Plica duodenojejunalis. 5. Sutured part of gastric stump. 6. Anastomosis. 7. Efferent loop. 8. Blind pouch. 9. Line of amputation.

Discussion.—It may seem a paradox, but our radical procedure does nothing more, but carry out the principles of medical treatment. We have said, that medical treatment aims rest and neutralization. A gastric resection achieves the same. It surely relieves all spasms and lowers the acidity considerably.

Gastrectomy has been called mutilating, destructive. It really only creates simpler conditions. Gastrojejunostomy is surgically a smaller interference but upsets the normal function of the stomach considerably. One of two things can happen. Either the ulcer heals, the pylorus opens and we have two openings, a vicious circle and a constant filling of the proximal loop; the same diseased state appears as in an unnecessary anastomosis; or the pylorus is closed completely by scar tissue, all gastric contents move through the

anastomosis. The regurgitation of the duodenal contents is not possible through the pylorus, the neutralization is faulty and the chances of a jejunal ulcer are great. Mann's extensive studies on experimental ulcers speak very much for this point. In diverting the secretions which neutralize gastric juice to a farther point, he obtained typical chronic peptic ulcers in a high percentage of cases. Between these two extremes lies the bulk of cases with no complete relief of spasms, with no lowering of acidity and with a mechanism to which nature has adapted itself, but which may be upset very easily. In the present time when one is apt to think more of function than of anatomical integrity, gastrectomy does not seem to be much more destructive than an anastomosis.

The difference between these statistics and those published in this country is striking, especially in the case of gastro-enterostomy. Our charity material, coming late for operation and unable to observe a post-operative diet may be partly responsible for the great number of recurrences and jejunal ulcers. Gastrectomy then is also a social indication.

Gastric surgery is still in its evolution. We seem to have swung back to the time of Billroth, who in 1881 first advised a radical resection. A combined effort of the internist and surgeon might bring a further lowering in mortality. At the present time, on the basis of the statistics above, in case of unsuccessful medical treatment a radical procedure for gastric and duodenal ulcers seems advisable.

A STUDY OF 6797 SURGICALLY REMOVED APPENDICES

By Shields Warren, M.D.

and

Alice S. Warren

of Boston, Mass.

from the pathological laboratory, of the boston city hospital

Since January 1, 1914, 6797 appendices have been examined at the Pathological Laboratory of the Boston City Hospital. Most of them were received from the operating rooms of the hospital, a number from the Carney Hospital, and the remainder from surgeons in private practice. By far the commonest cause of removal of the organ was a diagnosis of appendicitis, though routine removal in abdominal operations for other conditions, particularly gynæcological, provided a large number. The practice of removing "interval appendices" has considerably raised the proportion of those diagnosed as "healed." Owing to lack of clinical data no attempt has been made to group the cases according to pre-operative diagnosis.

This study was undertaken to check the value of the criteria used for diagnosis of the various pathological types of appendicitis, and to determine the incidence of some of the rarer lesions.

The same method of examination of the appendices has been followed throughout with but few exceptions. The gross appearance of the organ is noted when received, and the unopened appendix is fixed *in toto* in alcohol-formalin. Occasionally portions which appear of unusual interest are fixed in Zenker's fluid. After fixation four pieces (for the past year three only) are cut from the appendix—one 0.5 cm. from the tip, one near the proximal end, and the others at any points of apparent interest. After imbedding in celloidin, sections are cut and stained with hæmatoxylin-eosin. In this way there is little likelihood of missing any pathological process.

The sections are examined by the assistants and internes in the pathological laboratory, and their diagnoses are checked by the pathologist. In the present study some of the slides diagnosed as acute and as healed appendicitis have not been reëxamined. In only very rare instances does the diagnosis recorded in this report differ from the original diagnosis.

The two essentials for the diagnosis of acute appendicitis are the presence of pus in the lumen of the appendix and some evidence, even though slight, of inflammation in the wall. No attempt has been made to subdivide acute appendicitis into gangrenous, phlegmonous or ulcerating types owing to the artificial character of such a classification. One portion of a given appendix may serve as a text-book illustration of phlegmonous appendicitis, while nearby the process is frankly ulcerative. Moreover, perforation is not a prerequisite of peritonitis.

The study of these acute cases has further strengthened the views of the writer [1] that acute appendicitis is enterogenous in origin and that no one specific organism causes the lesion. Oxyuris was an incidental finding in three cases only of acute appendicitis, less than 0.15 per cent. of the total cases of acute appendicitis.

The number of acutely inflamed appendices was 1849, or 27.20 per cent. of the total.

The border line between acute appendicitis and healing appendicitis on the one hand and healing and healed on the other is not easily determined. The point when the eosinophiles in the wall of the appendix outnumber the neutrophiles and the fibroblasts show evidence of proliferation has been arbitrarily chosen for the first. When less than six eosinophiles are present in the muscularis of a single section, the lesion is considered as healed rather than healing. The lesions which show only a few eosinophiles have been called late healing. Eight hundred and eighty-one, or 11.49 per cent., were diagnosed as healing. Of these, 98 were noted as late healing. The lumen of the healing appendix may be obliterated for a portion or all of its length; if the former, the condition is known as healing appendicitis with partial obliteration, of which seven instances were encountered, if the latter, healing appendicitis with complete obliteration, of which we found 30. In 28 cases the healing appendicitis is complicated by a periappendiceal abscess.

By far the largest group is that of healed appendicitis. The great bulk of cases diagnosed clinically as "chronic appendicitis" fall in this classification. The criteria are simple—collections of lymphocytes either in lymphatics or in the tissues of the muscularis or serosa. There may or may not be definite evidence of scar formation in the wall. Often the amount of fat in the submucosa appears much increased, though this is not a constant finding. Under this heading 2445, or 35.97 per cent., are included. The amount of glandular epithelium remaining viable after subsidence of the inflammatory process determines the extent to which the lumen remains patent. A portion of the lumen is obliterated in 95 healed appendices, and all the lumen in 336. Two of the appendices with completely obliterated lumina contain foci of calcification, which in one has progressed to true bone formation.

The terms applied to the various types of recurrent appendicitis are self-explanatory, and the number of cases of the various types are given in Table I.

We believe that the term periappendicitis should be restricted to those cases in which the submucosa and mucosa are not involved in the lesion and in which the source of infection is the peritoneal cavity. Hence, with the exception of tuberculous periappendicitis, we do not make a diagnosis of periappendicitis in males. The presence of granulation tissue and a predominance of eosinophiles or lymphocytes in the exudate mark the transition of the lesion from the acute to the chronic stage. In our series are 61 cases of acute periappendicitis, 8 additional cases complicated by periappendiceal abscess, and 238 cases of chronic periappendicitis.

In the appendix the lesions of tuberculosis resemble those produced in

other organs. We encountered tuberculous periappendicitis 15 times and tuberculous appendicitis 30. Two additional appendices show healed lesions of tuberculosis in the muscularis.

Typhoid fever also is readily recognizable, the lesion differing but little

TABLE I

Incidence of Appendiceal Lesions

Diagnosis	No. of cases	Per cent. of total
Acute appendicitis	1849	27.20
Healing appendicitis	881	11.49
Healing appendicitis with partial obliteration	7	00.11
Healing appendicitis with complete obliteration	30	00.44
Healing appendicitis with periappendiceal abscess	28	00.41
Healed appendicitis	2445	35.97
Healed appendicitis with recurrent acute appendicitis	42	00.62
Healed appendicitis with recurrent acute appendicitis and partial obliteration	7	00.11
Healed appendicitis with recurrent healing appendicitis	7	00.11
Healed appendicitis with recurrent healing appendicitis and partial obliteration	7	00.11
Healed appendicitis with recurrent healing appendicitis and complete obliteration	4	00.06
Healed appendicitis with partial obliteration of lumen	95	01.40
Healed appendicitis with complete obliteration of lumen.	336	04.94
Acute periappendicitis	61	00.90
Acute periappendicitis with periappendiceal abscess	8	00.12
Chronic periappendicitis	238	03.50
Typhoid appendicitis	1	00.01
Tuberculous appendicitis	30	00.44
Healed tuberculous appendicitis	2	00.03
Tuberculous periappendicitis	15	00.22
Oxyuris and acute appendicitis	3	00.04
Oxyuris and healing appendicitis	4	00.06
Oxyuris and chronic appendicitis	1	00.01
Oxyuris and healed appendicitis	43	00.63
Oxyuris in negative appendix	5	00.07
Tenia in negative appendix	1	00.01
Mucocele	5	00.07
Carcinoid	26	00.38
Neuroma	1	00.01
Malignant adenoma	3	00.04
Colloid carcinoma	2	00.03
Cancerous periappendicitis	1	00.01
Lymphoblastoma	2	00.03
Negative	607	08.97
	6797	

from the one typically found in the intestinal lymphoid tissue. Only one instance of typhoid appendicitis was found.

The appendices containing oxyuris we have grouped together in Table I merely for convenience. We do not feel that the worm has more than a

passive relationship to the pathological processes except in one case, which we have diagnosed as chronic appendicitis due to oxyuris. The mucosa and submucosa as well as a regional lymph-node are definitely the seat of chronic inflammatory process, and the lumen was packed with the oxyuris.

One appendix, otherwise, negative, contained several segments of a Tenia.

In 607 appendices, 8.97 per cent., no pathology is demonstrable. Not all of these were removed in the course of an operation for some other condition.

A certain number of pathological curiosities have also been observed. Among these may be mentioned 5 cases of mucocele. During the same period of time 2 cases, one of the "globoid body" type, were encountered in autopsy material.

One appendix shows a piling-up of nerve and connective tissue in the scar of a healed appendicitis comparable to an amputation neuroma.

The tumors in this series are of considerable interest. The commonest is the so-called carcinoid, of which we have 26 cases, 0.38 per cent. In Table II is shown their distribution by sex and by condition of the appendix. A decided preponderance of these tumors in women is indicated.

TABLE II

Occurrence of Carcinoids

	Male	Female	Unknown
Acute appendicitis	1	3	
Healed appendicitis	2	16	4
Total	3	19	4

Of three cases of malignant adenoma, two are primary in the appendix. The other involves the appendix by extension from the primary focus in the cæcum. Both the cases of colloid carcinoma were primary in the appendix.

One appendix diagnosed as cancerous periappendicitis was removed from a case of carcinoma peritonei.

Two cases of lymphoblastoma involve the appendix by extension from the cæcum.

Discussion.—Very rarely appendices are encountered which contain pus in the lumen, but show no evidence of inflammation in the wall, either in gross or in the sections taken for microscopic study. These we have classified as acute appendicitis, but perhaps they might be better diagnosed as chronic appendicitis, in as much as the inflammatory process is very mild and the clinical history suggests a long course.

As regards recurrent appendicitis, it is worthy of note that it is of relative rarity, and that acute recurrent appendicitis did not occur in any of the appendices with completely obliterated lumina. Healing recurrent appendicitis was present in four appendices with complete obliteration of the lumen, but here the obliteration might well be a result of the healing process. We believe that an appendix with completely obliterated lumen cannot become inflamed, except as a periappendicitis.

One lesion which does appear to be more frequent in healed appendicitis than in negative or acutely inflamed appendices is the carcinoid. As can be seen from Table II, 22 out of the 26 cases occurred in appendices showing evidence of past inflammation. We believe that this throws some light on the etiology of the lesion. It seems not impossible that during the healing of an acute appendicitis some of the cells at the bases of the crypts of Lieberkühn, argentaffine or otherwise, should become isolated in connective tissue or even muscle fibres and multiply in this location. In chronic salpingitis somewhat analogous epithelial masses may be occasionally encountered far out in the muscularis. Jackson [2] believes that chronic appendicitis may be an important factor.

Our percentage of carcinoid (0.38) is practically that found by McWilliams [3] in his large series. The marked predominance of females in our cases is noteworthy.

The number of appendices in which oxyuris was encountered is strikingly low. This, however, is obviously due to the method of examination. The presence of oxyuris would not be noticed unless one or more worms happened to be in the regions sectioned. In only one case did the parasites seem to have any relation to the inflammatory process—the one given in the table as oxyuris and chronic appendicitis. This case would seem to fulfill Brauch's[4] criteria for appendicopathia oxyurica.

SUMMARY AND CONCLUSIONS

1. Criteria for the pathological diagnosis of the various types of appendicitis are offered, based on 6797 surgically removed appendices.

2. The diagnosis of chronic appendicitis is rarely justified pathologically, and should be reserved for those cases in which pus is present in the lumen without evidence of inflammation in the wall.

3. Benign tumors of the appendix, the so-called carcinoids, may be of inflammatory origin. They occur far more frequently in females than in males in this series. These 26 cases of carcinoid have not been previously put on record.

4. Oxyuris is rarely the cause of pathological change in the appendix.

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PYELOGRAPHY IN RENAL DIAGNOSIS*

By Leon Herman, M.D.

of Philadelphia, Pa.

Renal studies have become so perfected that the rarer lesions alone excite unusual interest. Of the various procedures employed, pyelography has shown probably the greatest development not only in technical perfection, but also in permitting a practical pictorial classification of pelvic deformities into groups more or less characteristic of the underlying pathology. In attempting to interpret pyelograms that present deviations far removed from the familiar standards in abnormality of pelvic outline, one is handicapped merely by inexperience. For this reason, there is greater educational value in the study of the extremely bizarre in pelvic outline, than in large collections showing only slight variations from the well-known standards. A wide familiarity with pelvic deformities, due either to congenital anomalies or surgical diseases, aids materially in the proper evaluation of data obtained by renal functional studies, clinical symptoms and physical signs. A description, therefore, of some unusual pyelograms, together with certain clinical and technical considerations will not be without practical value.

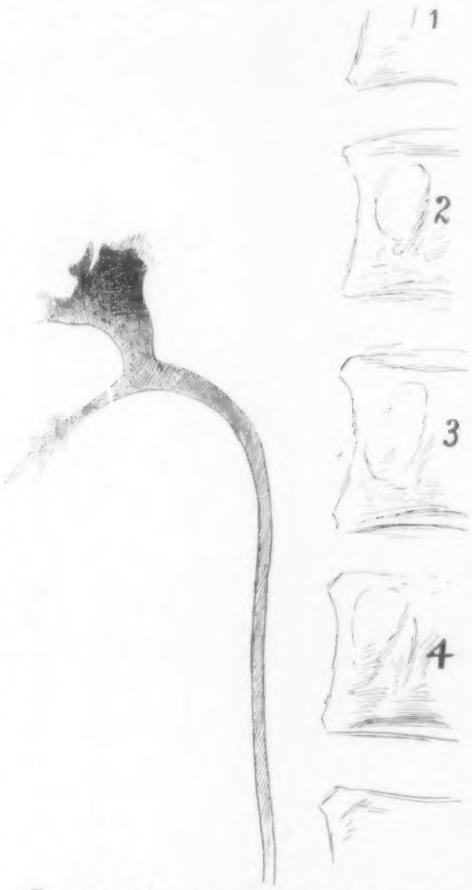

Fig. 1.—Outline of the pyelographic shadow in a case of infected polycystic kidney. The pelvic deformity is suggestive of that caused by hypernephroma.

Technical Considerations.—Technical perfection in pyelography implies equal appreciation on the part of the urologist and röntgenologist of its diagnostic value. This is especially true when the data is obtained largely from fluoroscopic observations of the injected pelvis. The examination must be conducted by one familiar not only with röntgenology, but also with pyelographic technic and the wide range of pelvic deformities which it reveals.

* Read before the Philadelphia Academy of Surgery, November 2, 1925.

We reserve the fluoroscopic method for use in cases in which it is desirable to observe the range of mobility of the injected pelvis. Thus in the diagnosis of movable kidney and in the differentiation of the renal from the extra-renal mass, this method has the advantage that in cases of extra-renal tumors situated in the renal area, the tumor may perhaps be moved bimanually under vision without dislocating the shadow of the injected pelvis. This rather limited use of the method results from our experience that for other purposes,

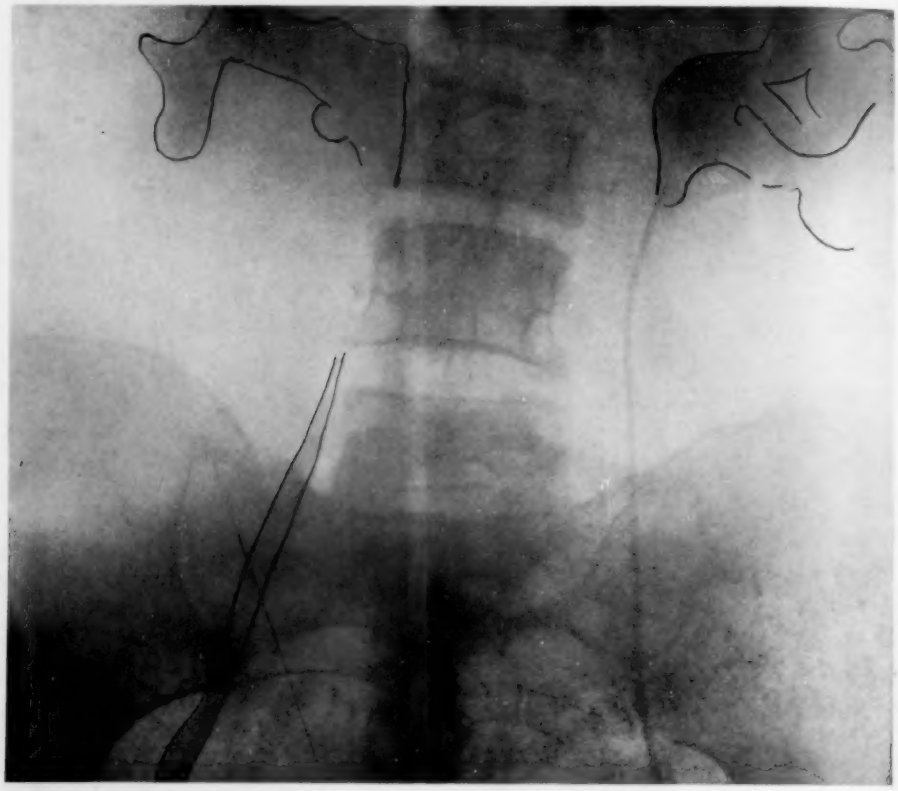

FIG. 2.—Pyelogram in a case of bilateral polycystic kidney. Note the extreme irregularity of the pelvic shadow due in part to pressure of the cysts on the pelvis, and in part to rupture of the cysts into the pelvis.

stereoscopic Bucky diaphragm plates are easier to interpret, and yield more valuable data, and with greater certainty.

The fallability of both the fluoroscopic and plate methods is well illustrated in a case in which we were convinced that a large tender mass in the upper right abdomen could be moved from before backward without displacement of the pelvic shadow. Direct inspection of the injected pelvis, as well as the plate disclosed, however, marked deformity of the pelvic outline. (Fig. 1.) This evidence not only discredited the clinical diagnosis of infected movable kidney, but indicated likewise, either that the fixation was apparent and not real, or that we were dealing with a renal lesion in association with an extra-renal mass. The pelvic deformity as revealed in the plate indicated not only

the presence of a renal lesion, but was of a type highly suggestive of hypernephroma. This pyelogram is truly bizarre, but it presents a deformity having more in common with the spider leg pyelogram so characteristic of hypernephroma than with any other renal disease or anomaly. Operation disclosed an infected polycystic kidney. This is an instance where the pelvis suffered obliterative changes in outline and assumed a type far removed from that characteristic of polycystic kidney to aproach the type very suggestive of hypernephroma. This led us to disregard the very important fact that the

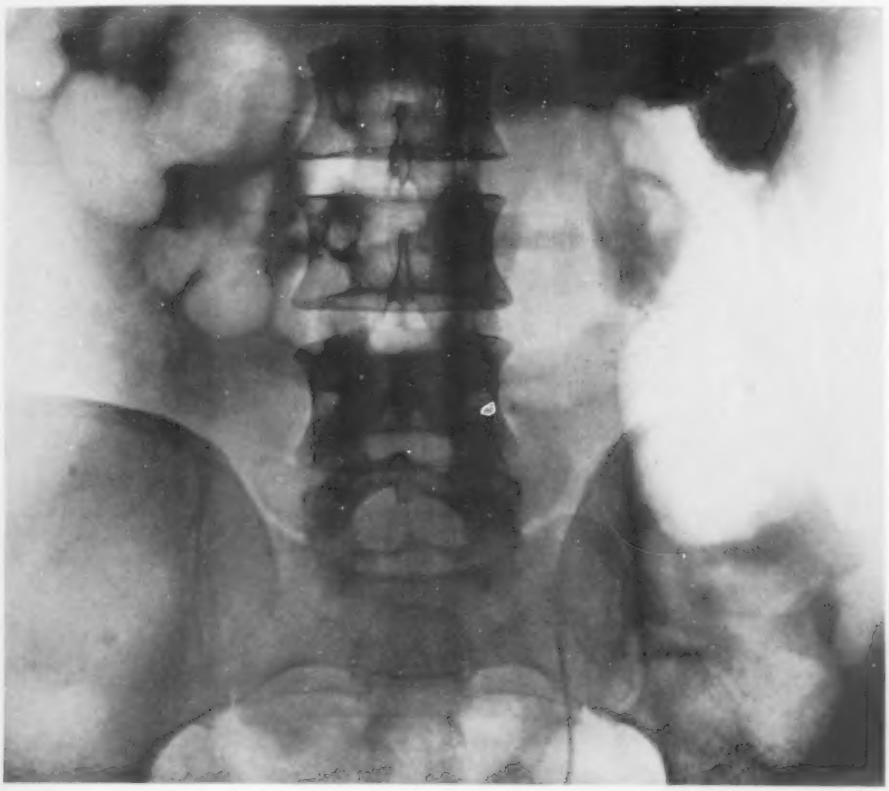

FIG. 3.—(See also Fig. 4). Pyelogram in a case of caseo-cavernous tuberculosis. The shadow represents a mass of silver iodide solution.

opposite and non-palpable kidney was low in function without obvious cause. In our experience, this is almost pathognomonic of polycystic kidney in the presence of a unilateral renal mass, since in other surgical diseases of the kidney giving rise to unilateral enlargement, the opposite kidney is either increased in function as the result of compensatory hypertrophy, or, if the function is depressed, the cause is more or less obvious. (Fig. 2.) In obscure cases such as the foregoing, bilateral pyelography at different sittings, is strongly indicated.

Before injecting a pyelographic medium, the capacity of the renal pelvis should be measured accurately. This we do routinely by injecting normal saline solution until the pelvic walls are under moderate tension as can easily

be determined by removing the needle from the catheter from time to time and noting the rate of return flow. Having determined the amount of medium necessary to obtain adequate distention of the pelvis, pyelography can be carried out painlessly by the syringe method, and with greater safety than by the gravity method.

Fluids injected into the renal pelvis, even under moderate degrees of pressure, may become widely disseminated throughout the renal parenchyma, which fact rationalizes the exclusive use of media for pyelography that are

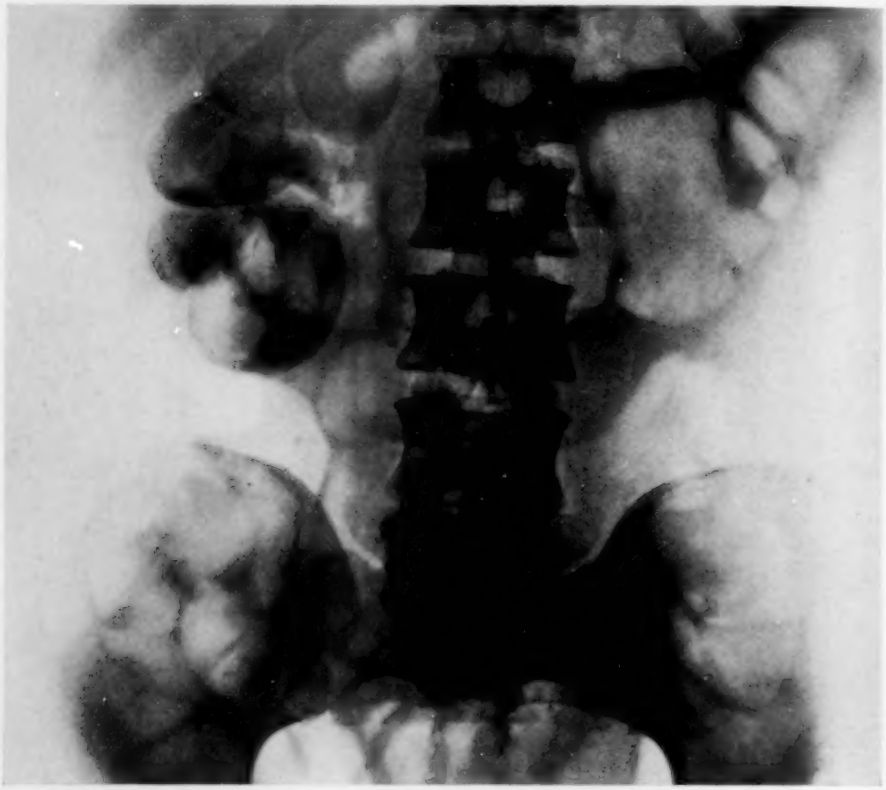

FIG. 4.—(See also Fig. 3). Röntgenogram taken one month after the injection of thirty c. c. of silver iodide solution. The medium has been retained and has become disseminated throughout the contents of the caseo-cavernous tuberculous kidney.

free from particles held in suspension. As long ago as 1916, Braasch and Mann [1] showed that the greatest danger in the use of silver preparations is their retention in actively secreting kidneys, and that silver iodide in solution is less harmful than the colloidal silver preparations. We mention this fact for the reason that silver iodide has again been recommended as a pyelographic medium on the basis of its antiseptic properties.[2] In marked states of upper urinary stasis, the injected fluid remains for variable periods of time. The irregular shadow in Fig. 3 represents a mass of silver iodide solution which was injected into the pelvis of the kidney the seat of advanced caseo-cavernous tuberculosis. Figure 4 is that of a röntgenogram in the same case,

made one month later without further injection; the medium has been retained and has become widely disseminated throughout the contents of the pelvis.

It suffices for all practical purposes to assume that the tendency to diffusion of pyelographic media exists, and that the most important contributing cause to such diffusion is increased intra-pelvic pressure. We present a most extraordinary pyelogram (Fig. 5) which would seem to indicate that in rare instances a pyelographic medium (one in three thousand mercuric iodide, in twelve per cent. sodium iodide solution), when injected into the pelvis of the

FIG. 5.—Pyelogram showing tubular filling. There was an intracortical abscess at the lower pole of the kidney at which point the tubules are not filled.

human kidney may enter, and become widely disseminated within, the lumina of the uriniferous tubules in quantities sufficient to outline the tubular system in the röntgenogram. The injected tubules are represented by lines which radiate fan-wise from the minor calyces. This condition was produced by the injection of twenty c.c. of the sodium iodide solution under somewhat greater pressure than is used ordinarily in the making of a pyelogram. It will be noted that the pyelogram is peculiar only in the fact of tubular filling; the pelvic is normal in outline. The differential functional studied showed very slight diminution in function of the right kidney and the urine was both sterile and pus free. There was the history in the case of a severe injury to the right loin followed by one year of invalidism due to pain in the right

loin space and right upper abdomen. Immediately following the receipt of the accident, hæmaturia was noted and after some months, the patient states that a large quantity of pus was voided. During the patient's residence in the wards of the Pennsylvania Hospital, we noted an irregular course of fever associated with a moderate leucocytosis, and tenderness in the right loin space and over the region of the gall-bladder. Dr. Charles Mitchell, in whose service the case occurred, and the writer, decided upon exploratory abdominal operation which revealed no abnormality except two nodules which could be

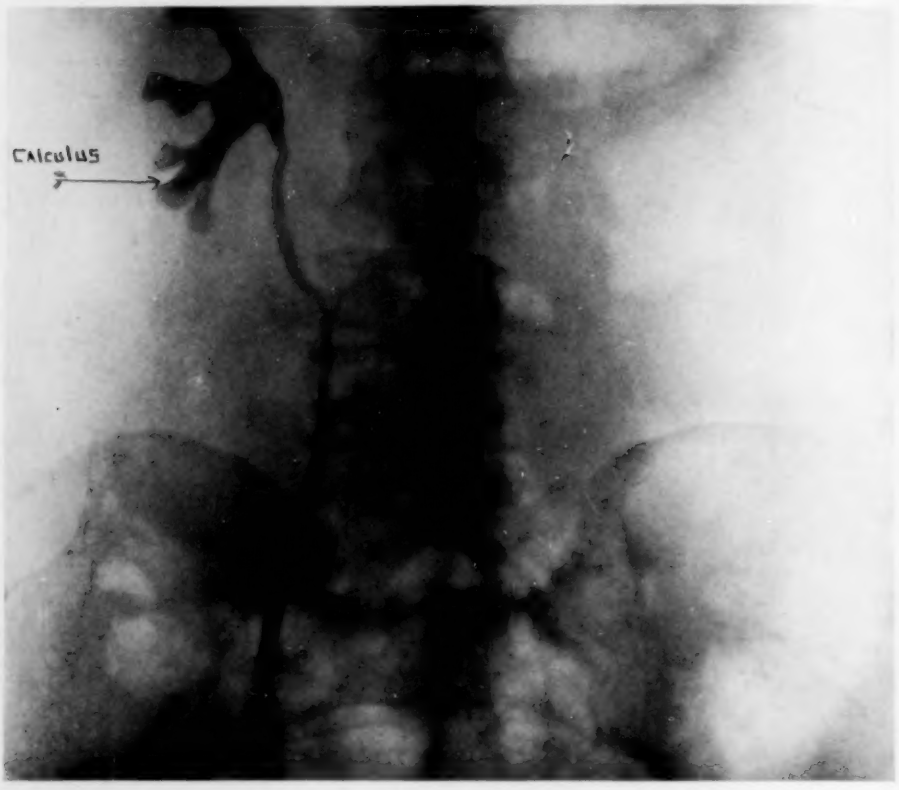

FIG. 6.—Pyelogram in the case of a small calculus impacted in the lower posterior calyx. The isthmus was narrowed proximal to the stone.

felt deeply embedded in the substance of the right kidney. These proved to be chronic intracortical abscesses separated from the surrounding grossly normal cortex by thick walls of well-organized scar tissue; there was no evidence of perirenal infection, the capsule being perfectly normal.

The relationship between this rare kidney lesion and the production of tubular filling is an interesting speculation. Owing to the chronicity of the renal abscesses, it is reasonable to assume that the pyelography had no part in their production, although parenchymal extravasation of pyelographic media is prone to occur, and in the presence of infection, it is reasonable to believe that it might produce a cortical lesion. The fact, too, that the pyelographic

study was not followed by the slightest systemic reaction may be taken as rather conclusive evidence that the renal abscesses antedated the injection of the kidney.

We report this primarily as one of the very few clinical demonstrations which tend to support the theory, that tubular filling is the means of the intraparenchymal dissemination of fluids injected into the pelvis of the kidney.

Hinman and Lee-Brown seek to explain the accidents of pyelography on

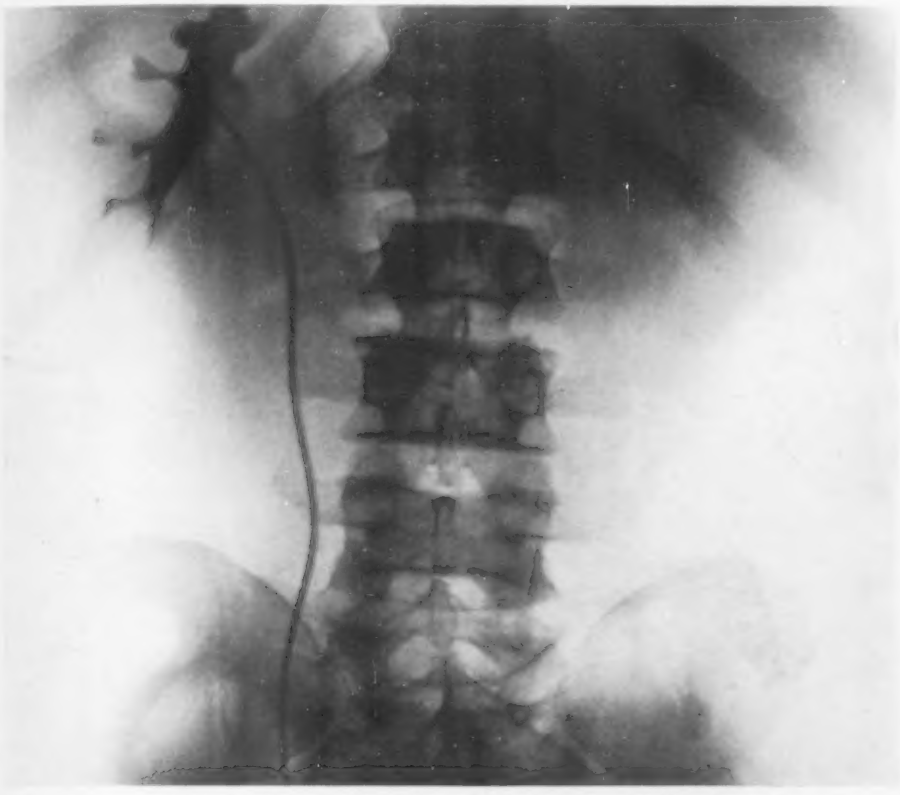

FIG. 7.—Pyelogram in a case of infected sarcoma of the kidney.

the phenomenon of pyelovenous backflow, which implies the direct entrance of fluids injected under pressure into the renal pelvis into the venulæ rectæ at the bases of the pyramids. The condition is due they say "to the fact that the rich plexuses of the venulæ rectæ at the bases of the pyramids are in close apposition with the deep sulci of the minor calyces." Hinman's conclusions are based on experimental studies, and some of the röntgenological evidence presented shows radiating lines of the injected fluid, but with a different distribution than in our case, and for the probable reason that they represent the medium disseminated in structures other than the uriniferous tubules. This writer holds that "pelvic distention would tend to close by compression this system tightly" and that "injection of the deeper renal

tubules is impossible by way of the ureter, and parenchymal extravasation requires pressure probably never produced clinically."

Hinman bases the theory of pyelovenous backflow on the most careful experimental work, but there are reasons for believing that in some instances at least, fluids injected into the pelvis pass into the uriniferous tubules and probably enter the blood vascular system through the glomerular circulation. Thus O'Connor[4] has shown that after pelvic lavage with solutions of silver nitrate the presence of metallic silver can be demonstrated in the most distant collecting tubules, and furthermore, that within twenty minutes after the injection of mercurochrome the drug had reached the glomeruli by passing directly up the lumina of the tubules, especially at the poles of the kidney where tears in the parenchyma are prone to occur under the circumstance of pelvic overdistention. Mason,[5] Burns and Schwartz[6] and many others submit corroborative evidence, but after discussing the opinions of these various observers, Hinman concludes that "all the clinical accidents following pyelography are primarily due to the structural phenomenon of pyelovenous backflow."

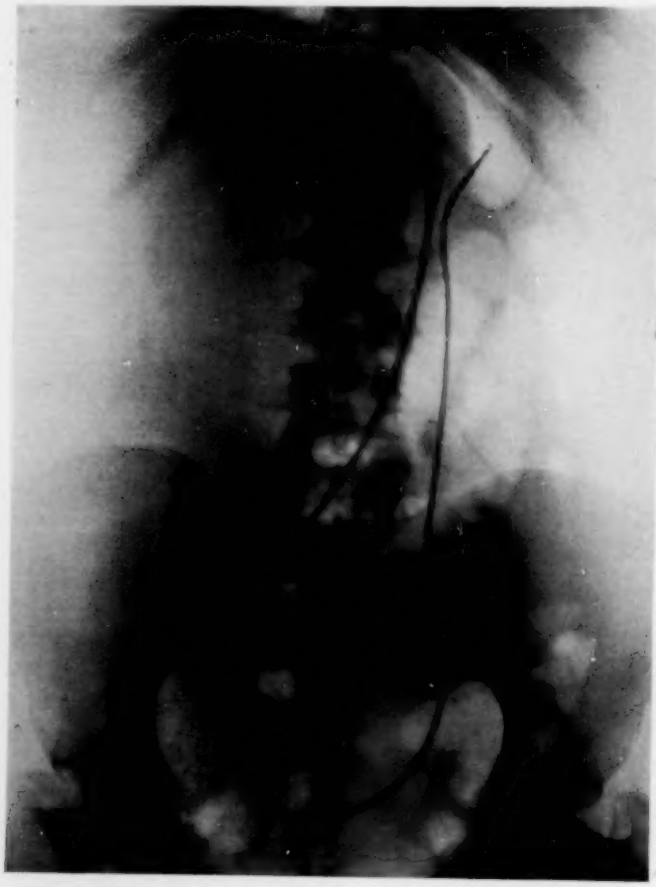

FIG. 8.—Pyelogram in a case of enormous solitary serous cyst of the left kidney. Note that the ureter has been displaced across the spinal column, and that the kidney has been pushed upward.

The findings in the human case herewith described would seem to indicate that in some few instances, for reasons as yet unknown, a pyelographic medium may be forced into, or enter an already open uriniferous tubular system.

Comparative Diagnostic Value of Pyelography and Renal Functional

Studies.—The routine use of the phenolsulphonephthalein test for differential functional determination has far wider applicability than pyelography in urological diagnosis. With extended use of the latter, however, one becomes dependent upon the data acquired, not alone for diagnosis, but as the means of predetermining surgical problems involved in various diseases of the kidney and upper ureter. This applies especially to the surgery of ureteral kinks, urinary stasis due to congenital or acquired abnormalities in the insertion of the ureter into the renal pelvis, and renal calculi, in which conditions,

FIG. 9.—Pyelogram showing ureteral kink.

pyelographic interpretation enables the operator to anticipate the necessary surgical procedures, and thereby simplify the operative technic. In cases of very small calculi impacted in the minor calyces, it is most desirable to learn pre-operatively if the involved calyx is situated anteriorly or posteriorly, whether the calibre of the isthmus is sufficiently large to permit one to deliver the stone into the true pelvis, and finally if the extra-renal portion of the latter is of sufficient size to perform pyelotomy if necessary. Figure 6 is illustrative of a small calculus impacted in the lower posterior calyx of the right kidney. These plates showed when viewed stereoscopically, that the stone occupied the lower posterior calyx, that the isthmus was somewhat contracted, that the stone was lying in the isthmus at right angles to its long axis, and finally

that the size and position of the pelvis in relation with the margins of the hilum of the kidney justified the belief that pyelotomy could be performed without difficulty. The stone was removed in the manner which the pyelographic study indicated would be the simplest procedure, namely, combined pyelotomy and nephrotomy, pushing the stone through a small nephrotomy wound with a finger in the pelvis. In some instances, pyelography yields information that changes entirely ones conception founded on clinical signs, physical findings and differential functional studies, of a seemingly obvious

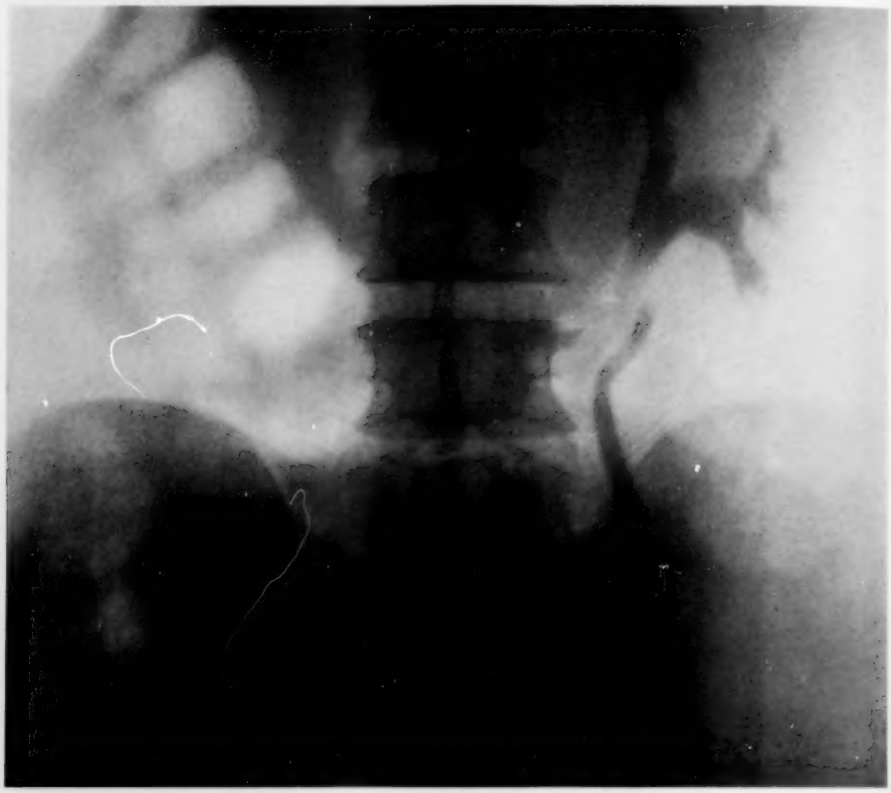

FIG. 10.—Pyelogram showing ureteral kink.

renal lesion. This is well illustrated in the case of a young man who came to the Pennsylvania Hospital complaining of a large tender mass in the upper left abdomen, associated with fever, chills, pyuria, and a high leucocytosis. The functional studies yielded the information that the left kidney was functionless and filled with thick purulent material; the right kidney was normal. It would seem that the diagnosis of pyonephrosis with an acute exacerbation of the infection had been fairly well established. In the absence of pyelographic data (Fig. 7), the operation would certainly have been advised in the belief that we were dealing with an uncomplicated infection. This peculiar "salamander like" deformity of the pelvis is clearly indicative

of the pressure effects on the pelvis of an unusual type of neoplasm, which proved to be a large sarcoma.

The pyelogram may yield important diagnostic data in renal as well as extra-renal conditions in the entire absence of alterations in renal function, or other evidence deductable from cystoscopic investigations. We report in this connection the pyelographic and cystoscopic data in the case of one of the rarest of renal lesions, namely, single or solitary serous cyst. The patient, a young colored woman, was admitted to the Pennsylvania Hospital under the

FIG. 11.—Pyelogram showing a filling defect of the true pelvis due to malignant papilloma of the renal pelvis. Note that the lower calyces are obliterated while the upper calyces are dilated.

care of Dr. Edward Klopp complaining of abdominal pain. A large mass was found in the upper left abdomen, the characteristics of which suggested its renal origin, but rather to our surprise the differential functional studied revealed little or no alteration in the elimination of phthalein from either kidney. These findings seemed to justify the opinion that the abdominal tumor was not of renal origin. It will be noted in the pyelogram (Fig. 8) that the left ureter has been displaced far to the right side, that the somewhat dilated pelvis has suffered complete rotation and lies transversely across the body of the first lumbar vertebra having been displaced far upward. With the additional information at hand, it seemed obvious that the lesion could

not be a renal neoplasm of the common type, yet the displacement of the left urinary tract indicated that the mass was retroperitoneal in position, and lying in juxta-position with the kidney. If the mass took origin from the kidney, it was of necessity of capsular origin, otherwise there would have been greater destruction of parenchyma as measured by the functional studies. We finally came to the conclusion that the mass was retroperitoneal in position, and that it had displaced the left kidney upward, all of which was correct but incomplete since the mass proved to be a cyst of the solitary serous type, which is believed to originate from lymphatic spaces in the true renal capsule. In this as in similar cases, the kidney had become flattened out over the cyst wall but had suffered surprisingly little pressure atrophy.

FIG. 12.—(See also Fig. 11). Malignant papilloma of the renal pelvis.

Another interesting and quite common condition that can be diagnosed only by means of the uretero-pyelogram, is kinking of the ureter, which may give rise to severe renal pain in the entire absence of obstruction sufficient to cause marked dilatation of the pelvis, or back-pressure atrophy of the parenchyma that could be detected by diminution in the percentage output of dye. (Figs. 9 and 10.) Figure 10 illustrates ureteral kinking due to traumatic injury. The patient, a colored man, suffered an injury to the right loin which was followed by hæmaturia and constant upper right abdominal pain. The uretero-pyelogram, which was made with the patient in the recumbent posture, shows a very marked kink of the upper ureter which we assume to be the cause of the patient's invalidism.

Tumors of the renal pelvis present unusual difficulties in diagnosis in the absence of more or less characteristic filling defects of the pelvis as shown in the pyelogram. Even in advanced cases associated with implants in the bladder and marked destruction of the kidney, the diagnosis of pelvic tumor is merely inferential unless the pyelogram reveals partial obliteration of the pelvic lumen. Figure 11 is illustrative of pelvic defection in the case of a malignant papilloma of the left renal pelvis associated with multiple secondary tumors of the bladder. The patient referred for examination by Dr. John Gibbon, complained of profuse symptomless hæmaturia. The routine cystoscopic examination revealed the presence of several small tumors situated at the summit of the bladder and two similar growths in the region of the bladder opening of the left ureter. The differential functional study,

which showed marked diminution in function of the left kidney, led to pyelographic examination with the results shown in Fig. 11. It will be noted that the cavity of the true pelvis and the lower calyces have been obliterated while the upper calyces are dilated, as the result of the presence of a large papilloma. (Fig. 12.)

Tumors arising from the pelvis at the uretero-pelvic junction or large tumors situated within the cavity of the true pelvis may render pyelography impossible, and one must rest content with the diagnosis of functionless kidney in the absence of secondary implants in the lower ureter or other evidence suggestive of the presence of a primary pelvic neoplasm.

In conclusion, may I be permitted to urge the necessity for complete urological study in obscure abdominal conditions, and especially in those in which upper abdominal pain is the prominent feature, for it is in the study of the unusual case that pyelography is most likely to yield important diagnostic data. Pyelography is not a procedure that can be employed with safety in cases presenting marked dysfunction of the kidneys, neither should it be used routinely in the study of the more or less obvious renal lesions. It is in our opinion, a diagnostic measure to be employed supplementary to the routine cystoscopic studies.

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THE ETIOLOGY OF THE POST-OPERATIVE PULMONARY ABSCESS

By Emile Holman, M.D.
of San Francisco, Cal.
From the Department of Surgery, of Stanford University Medical School

Pulmonary suppuration, following operative procedures, is commonly ascribed to the aspiration of infected blood and mucus. Most writers are willing to concede the possibility of a hæmatogenous infection, but are usually quick to add that they believe aspiration to be the most common cause of this unfortunate complication. However, the notable contributions of Fetterolf and Fox [1] have reëmphasized the embolic theory, and more recent experimental evidence brings them commanding support.[2]

In attempts to produce a pulmonary abscess in dogs, the smaller bronchi were completely plugged with infected material following scarification of the bronchial wall. Two of the animals died of an empyema, one of a massive pneumonia, and the other eight animals remained well. These negative results correspond closely with the experiences of numerous other investigators.[3] In marked contrast to these futile efforts, definite abscesses of the lung were produced in fifteen out of twenty-one attempts by introducing into the jugular vein infected emboli, which were held up in the pulmonary circulation. Here these emboli produced septic infarcts, followed by a softening of the pulmonary tissue, with subsequent cavitation and the formation of an abscess. Two of the animals died following perforation of the abscesses into the pleural cavity on the fifth and sixth days, respectively. In the six animals that recovered without the formation of an abscess, subsequent lobectomy revealed healed and healing infarcts.

Closely paralleling the experimental failures to produce an abscess by the introduction of infected material into the bronchi are numerous clinical experiences recorded in the literature. Chevalier Jackson,[4, 5] in a recent demonstration, presented a large number of most instructive observations. Metallic and organic foreign bodies which had resided in the bronchi for incredibly long periods of time (over thirty years in one instance), with putrefactive processes going on about them, had failed to produce any of the characteristic signs and symptoms of a pulmonary abscess. There was, indeed, considerable increase in density of the tissues around the foreign body, but the entire process had become well circumscribed with none of the evil systemic manifestations of a suppurative pulmonary abscess. Few showed any fever on their admission to the hospital, although some gave a history of an unexplained periodic fever, variously attributed by physicians to tuberculosis, malaria, bronchitis, and even to worms.

Jackson postulates some "unknown factor" which usually, though not invariably, provided a protective barrier to the development of pulmonary abscess in the presence of these foreign bodies in the bronchi, some of which

were exceedingly foul and obviously infected on extraction. In most cases immediate recovery followed the removal of the offending and offensive intruder.

In contrast to the picture presented by these patients, is that furnished by the unfortunate victim of a pulmonary abscess following some operative procedure. Such an abscess is characterized by a cavity within the lung, filled with foul pus which is expectorated in large quantities, and which makes life an intolerable burden to the sufferer. The presence of such a cavity is usually accompanied also by a toxic absorption which manifests itself by the characteristic systemic reactions of fever, rapid pulse, marked lassitude and weakness, and clubbed fingers.

What are the clinical manifestations that accompany the development of a pulmonary abscess in these latter cases? During the first few days following the operation the patient feels well. Indeed, if tonsillectomy has been performed, he is usually discharged from the hospital before any symptoms appear. It seems unlikely that the aspiration of infected material would be followed by an interim in which the patient is so entirely free of symptoms. Instead of an insidious onset, one would expect an abrupt and progressive development of trouble from the moment the aspiration had occurred. As a rule, however, it is not until the sixth to ninth day that the patient begins to feel ill and "good for nothing." About this time, he may complain of a pain in his side, a high fever may set in, accompanied by chills. Sputum resembling pus may be coughed up, which gradually increases in amount and fetor. Occasionally a history is elicited of a few days of fever, followed by a feeling of something having burst within, accompanied by the immediate ejection of a large amount of pus. A persistent, productive cough follows, but no association with the operation is postulated—the patient has been too well in the immediate interim following the operation to suggest a possible connection. The average period of time between the operation and onset of symptoms in one hundred eighty-seven cases of pulmonary abscess following operations performed under *general* anæsthesia, was six days. Moreover, the average elapse of time between the operation and onset of symptoms in thirty-four abscesses following operations performed under *local* anæsthesia was also six days.[6]

In our experimental animals the first röntgenographic evidence of an abscess was observed to appear about the fourth to sixth day, and to progress to the formation of a definite cavity on about the eighth to tenth day. This close parallelism between the average time of onset of symptoms in the clinical cases and the sequence of events in the experimental production of a pulmonary abscess, is striking and significant, and the inference may be made that the process is dependent in both instances upon the same factor, namely the presence of an infected embolus in the blood stream.

Certain deductions may also be made with reference to the "protective barrier" postulated by Jackson. In the case of an infected foreign body encysted in the bronchus, it may be said that the intruder is outside the

body, as, indeed one may consider food and infected material in the alimentary canal as being outside the body. There is interposed between the foreign substance and the tissues and fluids of the body a protective layer of intact epithelium. The blood supply to the region around the foreign body is not interfered with nor interrupted. The defensive processes of the body can proceed immediately and uninterruptedly to wall off the intruder on all sides. Thus, the foreign body is even more securely than before placed *outside the body*. On the other hand, an infected embolus lodged in the terminal branches of an artery, has broken down the first defense of the organism—the intruder is *within* the body. Such an embolus produces a septic infarct; an area of the lung is deprived of its blood supply, and the organisms which are present in the embolus, having "fallen on good ground," proceed without interference to multiply "a hundred fold." Meanwhile, the protective forces of the body are at a distinct disadvantage. Their lines of communication are broken. In the presence of an infective agent the bloodless, ill-nourished pulmonary tissue softens and liquefies, and cavitation follows. It is suggested that an intact undamaged blood supply may be the most important deterrent factor to the formation of a pulmonary abscess following the aspiration of an infected foreign body, and may constitute the protective barrier postulated by Jackson.

An interrupted blood supply may also be an important factor in the post-pneumonic suppurations which constitute the majority of all pulmonary abscesses. One may postulate the following sequence of events; the consolidation of the lobe affected by the pneumonic process may be accompanied by a thrombosis in the smaller vessels, precipitated by bacterial toxins. This thrombosis may interrupt the blood supply to a portion of the lung, and in the presence of an infecting agent this devitalized tissue softens and liquefies with subsequent cavitation.

The close parallelism in the failures to produce a pulmonary abscess by an infected foreign body in the bronchus, both clinically and experimentally, and the equally close parallelism in the times of onset of pulmonary suppuration observed clinically and experimentally would seem to place the embolic theory of post-operative pulmonary suppuration on a much firmer footing than the aspiration theory. The former also accounts quite adequately for those cases of pulmonary suppuration that follow the use of local anæsthesia. Moreover, it falls directly in line with Cutler's [7] theory that most post-operative pulmonary complications are probably due to a factor common to all operations, namely the transportation of emboli by way of the blood stream to the pulmonary capillary bed. The subsequent reaction of the lung to such an embolus depends largely upon whether or not the embolus is infected, upon the type of the infecting organism, and upon its virulence. Cutler has pointed out that the greatest incidence of the simpler pulmonary complications, such as a transient fever and tachypnœa, or a bronchopneumonia, is found in operations of the upper abdomen where emboli are more likely to be dislodged and catapulted into the blood stream by the constant movement of the organs and

tissues in this region due to respiration. On the other hand, the least incidence in pulmonary complications occurs in operations upon the scalp and cranium. Here the tissues are rigidly immobile, and not subject to muscular contraction.

If the embolic theory is the more important of the two, why are so many pulmonary abscesses directly traceable to tonsillectomy, to the extraction of teeth, or to operations about the mouth, and so very few, comparatively speaking, traceable to the numerous operations performed in other parts of the body?

In an explanation of this, Fetterolf and Fox have directed attention, first, to the sloughing that occurs in the mouth directly upon the surface of the pterygoid and pharyngeal muscles following the complete enucleation of the tonsil, and, second, to the constant movement of these muscles of the throat and neck. The first factor, they say, favors septic thrombosis in the vessels and the second factor causes dislodgement of the infected emboli into the blood stream. These suggestions may be still further elaborated. McLean [8] and others have asserted that thrombosis is dependent upon infection and that clotting within vessels usually does not occur, even though the intima be injured and lacerated, if no infection is present.

The application here is obvious. In clean operations about the neck and other parts of the body, bleeding is controlled by ligature and by retraction of the vessel walls without significant thrombosis within the vessels. If a post-operative complication should appear, due to a sterile embolus, suppuration is unlikely. However, in operations about the mouth, thrombosis is likely to occur in many more of the vessels that are divided since their cut ends are invariably contaminated by infection. The resulting clot may organize and may remain safely anchored by attachment to the vessel wall. In other instances, however, the infection that precipitated the thrombosis may be responsible also for the failure of the clot to remain attached to the vessel wall; it is swept off into the blood stream and finds its way into the pulmonary circulation to raise what mischief it may. Is it possible that the negative pressure so frequently observed in the jugular vein may be partly responsible for the "sucking" of these loosened thrombi into the venous blood stream? This factor, in addition to the constant movement of the muscles of the neck and pharynx may play some part in the dislodgement and transference of the infected clot to the lungs. It may also be an additional factor in the high incidence of septic emboli from this particular field.

Since the advent of more careful and accurate physical and laboratory examinations, the incidence of recognized post-operative pulmonary complications has risen remarkably. Cutler finds that they occur in six per cent. of all post-operative cases. If we accept the theory that these complications are embolic in origin, and that their manifestations are due to small aseptic pulmonary infarcts, is it not logical to assume that tonsillectomy may also have its incidence of emboli, the important difference being that a certain number may be septic emboli capable of producing abscesses in a manner identical with

that seen in the experimental animal? Studies by Moore [6] indicate that we may expect a pulmonary abscess to occur once in every three thousand tonsillectomies. This probably does not represent the total number of pulmonary complications incident to tonsillectomy, if one may judge from Cutler's studies which show that we may expect some form of pulmonary complication once in every sixteen operations in other parts of the body. The following brief history illustrates a pulmonary complication following tonsillectomy probably due to an infarct from the operative field which did not, however, go on to the formation of an abscess. A small boy, six years of age, had a tonsillectomy performed under ether. He was discharged on the third day, apparently well. Nine days after the operation, he returned to the hospital dispensary with a history of having had three days of cough, fever, night sweats and pain on the left side on breathing, which had confined him to bed but which were then much improved. Gradual and complete recovery followed. This observation suggests that an instructive line of investigation would be a careful study of all cases of tonsillectomy for eight to ten days following operation to determine the incidence of the minor pulmonary complications, as disclosed by fever, increased respiratory and pulse rates, and röntgenographic evidence of infarction or consolidation. If their occurrence, as compared to similar complications following operations elsewhere in the body, was found to be unusually high, it might throw additional light on the high incidence of pulmonary abscess following tonsillectomy. It is possible, also, that a study of large numbers of septic abdominal conditions requiring operation, and capable of throwing infected emboli into the blood stream, would show an incidence of pulmonary suppuration comparable with that following tonsillectomy.

SUMMARY

Experimentally, it has been found impossible to produce a pulmonary abscess by the introduction of septic material into the bronchus. Clinically, a true pulmonary abscess rarely develops in the presence of aspirated infected foreign bodies.

Pulmonary abscesses may be produced, experimentally, with uniform success by the introduction of septic emboli into the venous blood stream. Clinically, the development of post-operative pulmonary suppuration parallels closely the development of a pulmonary abscess in the experimental animal.

It is suggested that the protective barrier to the formation of an abscess in the aspiration cases is an intact blood supply. In septic infarction due to infected emboli, the blood supply is interrupted, and in the presence of infection the ill-nourished, necrotic pulmonary tissue undergoes liquefaction and cavitation.

A similar process of thrombosis and septic necrosis of pulmonary tissue may be the important factors in the mechanism of the production of the pulmonary abscesses that follow bronchopneumonia.

We are led to conclude from experimental and clinical observations that

post-operative pulmonary suppuration probably has its origin less often in the aspiration of blood and mucus than in the setting free of a septic embolus into the blood stream.

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THE TREATMENT OF TRAUMATIC RUPTURE OF THE KIDNEY*

By Miley B. Wesson, M.D.

of San Francisco, Cal.

Traumatic rupture of the kidney is not a rare lesion, although its treatment in text-books would indicate that it was very uncommon. Practically every surgeon has seen one or more cases, few have seen many and, with rare exceptions, only the unusual, complicated cases are recorded in the literature. However, newspapers have reported in the past two years that the football team of a local high school has suffered the loss of two players during games from traumatic rupture of the kidney, nephrectomy being done in each instance.

Although Galen [1] in 1561 described subcutaneous rupture of the kidney, little attention was paid to the lesion until the classical work of Rayer [2] in 1839. Since that time the literature has become voluminous. Various writers, reporting from one to six personal cases, have attempted to collect and analyze all of the instances recorded in the literature but, apparently because of the inaccessibility to the authors of many of the original articles, all of the tabulations are incomplete, even though some reports contain over nine hundred cases. The statistics as to the incidence of ruptured kidneys vary markedly, Küster [3, 4] finding ten cases in 30,000 admissions to the Basle Clinic. In 7741 autopsies, over a period of twenty years, he found that it occurred in 0.12 per cent. of all instances and in 8 per cent. of the deaths due to traumatic injury; Gütterbock,[5] in 326 post-mortem examinations, found kidney ruptures present in 10 per cent. of the cases.

The subject of treatment has always been controversial, there being ardent advocates of the three types of treatment—expectant, conservative surgery and nephrectomy. With the advent of workmen's compensation insurance other factors than pure science have complicated the problem. The layman has been educated to the idea that pain in the back, be it due to lumbago or secondary to a prostatitis, indicates kidney trouble. Hence, if there has been any trauma, this is as good a complaint for malingerers and as expensive for employers as the railroad spine of a decade ago or the more modern hypertrophic osteoarthritis. The insurance carrier wants the man back at work as soon as possible, preferably with two kidneys, and at a minimum expense.

Five instances of rupture of the kidney in which the patients were returned to work with both kidneys, one and one-half kidneys or one kidney, are briefly reported.

Etiology.—After a careful review of the literature, one is amazed at the frequency of kidney ruptures that follow inadequate force,[6] the degree of damage being out of proportion to the amount of injury; for instance who

* Read before the Nevada State Medical Association, September 5, 1925.

would suspect that a man would fracture his wife's kidney while waltzing with her [7] or a boxer receive such an injury while delivering a blow? [8]

Morris [9] was the first to ascribe to the floating ribs a certain share in the production of rupture of the kidney. Rayer [2] and Tuffier [10] called attention to the jarring caused by a blow on the body; Le Dentu [11] compared the injury to that experienced by the brain from a blow on the opposite side; Güterbock [5] suggested that a force squeezed the poles together, thereby producing transverse fissures; Schede [12] emphasized the possibility of throwing a distended kidney against the transverse process of a vertebra, while Küster [3] attributed most of the trouble to hydraulic pressure acting through the full vessels and pelvis and causing the organs to burst along the lines for the most part radiating from the tubules toward the point of maximum impact of the lower ribs, the opposing resistance being supplied by the vertebral column. However, the commonest modes of injury are: (1) A blow driving the kidney against the lower ribs or transverse processes of the first and second lumbar vertebræ; (2) concussion, and (3) abrupt flexion of the body.

Although it is the general impression that infected kidneys rupture more easily than uninfected ones,[13] there are no statistics available. Without doubt infection plays a very important part in the etiology of cases of non-traumatic rupture but is of little causative significance in cases due to external violence.[14]

Spontaneous rupture of the kidney is of particular interest because of the widespread interest in the new Wagner-Jauregg paresis therapy. Wade [15] reported a bilateral rupture following antisyphilitic treatment in a case complicated with malaria. Connell,[16] in 1916, collected from the literature 30 cases of spontaneous rupture due to arteriosclerosis, nephritis, stone, etc., any one of which could have been attributed to trauma and classified as an industrial accident.

Pathology.—The most satisfactory classification of kidney ruptures is that of Tuffier: [10] (1) Ecchymosis; (2) subcapsular rupture, and (3) total rupture. The subcapsular ruptures are considered benign, the injuries being followed only by infarcts, whereas the total rupture with a torn capsule and a laceration of the kidney pelvis is dangerous because of extravasation of blood and urine.

Injuries to the kidney are more common in males and the right kidney is most often the ruptured one, the posterior surface being the site of injury. A single tear is practically always transverse because the development of the kidney is parallel to the course of the tubules and vessels.[17]

Urine in the cellular tissue indicates a torn pelvis or ruptured calyx laid open,[18, 19, 20] since torn renal substance is not capable of secreting urine. If the urine is sterile and is not disturbed, it walls off and is generally absorbed, but if it becomes infected, suppuration follows. Peritoneal tears are common in children under ten on account of the connection between the peritoneum and the kidney.[12, 22]

Hemorrhage can be classified in four groups: (1) Hæmaturia; (2) perirenal; (3) intrarenal, and (4) intraperitoneal. If the capsule is not torn, the

resistance will increase gradually as the blood is poured out and tend spontaneously to arrest the hemorrhage. When the capsule is torn and the kidney deeply lacerated, but the perinephritic tissue not much disturbed, the blood and urine will accumulate about it, forming a pseudohydronephrosis. Morgagni [23] noted that when a kidney was severely lacerated the free hemorrhage from its substance so lessened the blood pressure that there was often an arrest of renal secretion in the injured side. The renal artery is sometimes torn off and stops bleeding, thrombosis occurring while there is a balance of pressure between the blood clots behind the peritoneum and the blood pressure within the artery. However, as a rule, the main artery is seldom damaged and the death of the part involved does not necessarily follow the occlusion of a branch. A large hemorrhage into the peritoneal cavity is fatal because of the lack of counter pressure; hæmaturia is generally absent because of clots in the ureter [24] and shock is the only symptom.

The mechanism of wound repair in the kidney is essentially the same as in any other parenchymatous organ—*i.e.*, the proliferation of the interstitial connective tissue of the gland bridges the gap between the two edges with the aid of a clot. The functioning elements of the gland degenerate and are replaced by connective tissue. Scar formation is rapid in the kidney and the process of repair has been shown far advanced after six days. The parenchyma is replaced by common scar tissue which is slowly permeated by scant newly-formed capillaries. There is no regeneration of tubules or glomeruli for the kidney is no more able to replace its glandular elements than is any other highly specialized organ.

Renal Counterbalance.—Buried in the foreign literature are reports of an immense amount of experimental work on the quantity of renal parenchyma necessary for life and it is agreed that one-fourth to one-third the combined weight of the two kidneys is sufficient.[25] However, this extreme reduction of the secretory field can last for only a few days, the temporarily stored up excrementitious substances causing grave symptoms of uremic intoxication, unless the remaining portion of the kidney has undergone a compensation hypertrophy in size and functional activity of the surviving elements that will care for it.[26] Numerous investigations proved that the hypertrophy was completed in 20 to 25 days and there was an increase of one-fifth to one-sixth in kidney volume. Dolgoff [27] found in dogs with a single kidney that any injury to cortex or medulla was fatal. Franklin [28] successfully removed one and three-fifths kidneys from a child suffering from bilateral traumatic rupture.

Symptoms.—The regulation train of events is: A fall, "felt sick," hæmaturia, dysuria and shock. The most characteristic symptom is hæmaturia and it is present in 90 to 95 per cent. of the cases. If the ureter and pelvis is torn off or the bleeding is into the peritoneal cavity, there will be no blood in the urine.[29] Hæmaturia is of minor importance, being merely the signal, the hæmatoma the measure of the lesion. Occasionally the tumor in the loin does

not appear until the seventh day or if the hemorrhage follows the sheath of the spermatics it may not reach the inguinal rings or roots of the penis until several weeks later.[30] Without incision or pyelograms it is impossible to tell whether or not the capsule is ruptured. Kolischer and Eisenstaedt [31] diagnosed a rupture of the kidney a week after the injury because of a persistent ecchymotic spot in the right flank and the observation through a cystoscope of the passage of a clot from the ureter.

FIG. 1.—Pyelogram of a healed kidney, three months after a traumatic rupture with retroperitoneal extravasation of urine; excision and drainage one month later. One-half of the kidney being destroyed, its function is reduced 50 per cent.

Shock that comes on after a lapse of several hours is due to hemorrhage, whereas if it occurs at time of injury it is not due to the kidney lesion but to an injury to the solar plexus. Reflex anuria of the uninjured kidney is not unusual and has even caused death. Even more interesting is reflex pain. Fieschi [32] described an instance where the surgeon was misled by the location of the pain and cut down on the uninjured kidney. Marshall [33] reported a case of traumatic rupture of the kidney treated by expectant method that returned to work on the twelfth day and developed severe pain on the 130th day due to subacute bilateral nephritis not dependent upon previous trauma but undoubtedly of infective origin. The nerves of a kidney are in the pelvis and not in the cortex, hence there can be no pain in a damaged kidney unless there is a pull on the renal pedicle.[34] Papin [35] and Ambard [36] have demonstrated that the kidney in its normal location is insensitive to pain and if the organ is exposed under the influence of a local anæsthetic, pinching it or doing a nephrotomy is painless. In other words, there can be no kidney pain as an aftermath of a traumatic rupture unless there is intrapelvic back pressure.

Treatment.—The treatment of rupture of the kidney has not yet been standardized [37] and unfortunately these organs are being handled today as were ovaries a generation ago, when it was a fad to remove them for trivial reasons.

The common procedures are: (1) Expectant treatment (let alone or later operation) for injuries where constitutional symptoms are absent and hæmaturia alone directs attention to the probability of a kidney lesion; (2) conservative surgery (tampon, suture or débridement) for a damaged kidney with a torn capsule, (3) nephrectomy for a destroyed kidney, and (4) abdominal incision for a torn peritoneum.

One would judge from the cases reported in the literature that nephrectomy was still the routine procedure. However, it is generally agreed that if the renal substance alone is only moderately injured, the pedicle being intact, conservative surgery is indicated. It is criminal to routinely do a primary nephrectomy, that procedure being reserved as a late operation,[38] and particularly when there is a widespread infection.[39] A fever does not necessarily indicate infection, as absorption of blood and urine will cause an elevation of temperature after a lapse of five to seven days.

A renal injury of moderate degree tends to recover spontaneously, but expectant treatment with rest in bed and an ice cap over the injured side for at least 48 hours should be insisted upon in all cases until the dangers from possible unusual complicating factors are over.[40] The indications for exploration are (a) immediate severe renal hemorrhage which endangers the patient's life; (b) steady hourly rise in pulse rate, and (c) anemia due to continuous moderate hemorrhage over many days. The recognized indications for nephrectomy are (1) tearing of the renal pedicle; (2) lacerations of the kidney in several places; (3) a tear extending toward the renal pelvis in a kidney whose short pedicle prevents delivering it so as to expose the rent for suturing; (4) an extensive tear in the renal pelvis which can not be repaired or a complete tear across the ureter, and (5) hydronephrosis or other severe disease of the injured kidney. Aside from severe hemorrhage there is no other justification for operation except infection. Since hæmatomata are easily infected, faithful supervision of the case is absolutely necessary if conservatism is attempted. Instrumentation is to be avoided when possible because of the danger of infection. However, large quantities of blood in the bladder with consequent clotting may lead to distention or tenesmus and require aspiration with a "clot sucker." Early and accurate diagnosis and prompt exploration in appropriate cases is imperative.

Prognosis.—Deep laceration and severe contusion are not fatal; a healed specimen in New York Hospital shows a complete horizontal division. In those unfortunates with a single kidney, a severe injury to that organ is probably always fatal.

It is fairly clear from a report of cases that more lives might be saved if timely operations were judiciously performed, and also that many nephrectomies could have been avoided if surgeons had not considered hæmaturia and

the history of a fall an indication for operation. In all cases treated expectantly, operation, if performed, should not be delayed too long.

Abdominal tumors may follow kidney ruptures that are treated expectantly. The swelling is not necessarily an effusion due to a necrotic kidney [20] acting as an irritant or the remains of a hemorrhage, but may be an accumulation of urine. When this is evacuated so as to relieve the pressure, the kidney and ureter will resume their normal function.

FIG. 2.—Overinjection with extravasation of 13½ per cent. sodium iodide solution between the tubules. Fig. 1 was made with an 18-inch column (gravity) and Fig. 2 by elevating the column to 24 inches. There was no pain and no reaction.

The argument is fallacious which assumes that the cases operated upon are the most severe and those not operated upon are the slighter injuries; also, the conclusion that if many of those treated palliatively had been operated upon, the mortality would have been materially further reduced. It must be admitted that the expectant plan is necessarily adopted in some of the very severest as well as in the slightest cases.

The comparative statistics in the literature are valueless and misleading since they are based either on false premises or an insufficient number of cases. Riese [41] in 1903, in 490 cases, found the mortality to be in expectant cases 21 per cent., conservative surgery 12 per cent., and nephrectomy 18 per cent. Lardennois [42] in an analysis of 767 cases in 1908 found a mortality of 20 per cent. in uncomplicated untreated cases; 28 per cent. in the expectant, or late operation group; and 18 per cent. in the cases operated upon immediately. Ponomareff [43] reported, in detail, a series of 123 cases (57 personal) treated expectantly with a mortality of 9 per cent.

One would expect that the reports from the various State Industrial Acci-

dent Commissions would furnish accurate data as to the amount of impairment arising from a ruptured kidney. However, their data is not tabulated and too often their ratings are copied bodily from the obsolete French reports,[44] where Ollive and Le Meignen [45] rated nephrectomy cases as having 40 to 50 per cent. total disability. The California Industrial Accident Commission considers the loss of a kidney as equal to the loss of an eye [46] and rates them at 20 per cent., or 80 weeks compensation. This fact is apparently not generally known for although many industrial nephrectomies are done,[47] less than 6 cases have appeared in the last three years before the Commission for a rating.

The life insurance companies take a more optimistic view of the after effects of such an injury. The most conservative hold that a nephrectomy on a forty-year-old man impairs him to the same extent as a blood pressure of 160 mm. Gage,[48] however, holds that " rupture of the kidney may be followed by complete recovery and leave no trace of the damage. Even if the injury requires the removal of the kidney, the other kidney quickly accommodates itself to the extra work and performs its function without any tendency to early degeneration. Such cases are probably at least average risks."

Discussion.—The time element in the cases treated without operation is an important and expensive factor for the insurance carrier. If a nephrectomy is done a man either promptly gets well or dies, whereas if following expectant treatment he complains of pain, a subjective symptom the presence or absence of which can not be demonstrated, he may become as expensive as the old-time " railroad spine " case. A careful, detailed study of the literature furnishes not one authentic case of pain in an uninfected healed kidney; furthermore, careful physiological researches have adduced no evidence that pain is possible. In those cases where there is no pull on the renal pedicle and no infection, the complaint of pain should receive no consideration. If a workman with one and one-half kidneys has his good kidney destroyed by subsequent injury, the organ first injured will take over all the kidney function, whereas if radical surgery had been done, there would be an immediate exitus. A healed kidney, free of infection and casts, with a good phthalein and no evidence of defective drainage of the pelvis can not be a source of pain. Conservative treatment is best for the man, but if expensive imaginary pain keeps a man on the compensation list for months, it becomes an important factor and it will only be a question of time until nephrectomy will become the routine treatment.

The appended brief case reports illustrate various degrees of kidney injuries and their treatment.

Case I (No. 303).—S. G., thirty-two-year-old male, was crushed between a moving car and a tunnel wall on April 14, 1914. The following day, when seen by W. H. Winterberg, he was voiding bright red blood. The profound shock and abdominal rigidity pointed toward internal injuries. After twenty-four hours expectant treatment the urine was clear; a voided second glass specimen was sterile. The right side of the abdomen was relatively soft but the left was rigid as a board and exquisitely tender. This condition disappeared very slowly, and hence he was not discharged from the hospital until May 14; he voluntarily returned to duty on June 28, 1924.

Comment.—The hemorrhage stopped spontaneously; the rigidity of the left side was apparently due to extravasation of blood in the muscles which was slow in absorbing.

CASE II (No. 397).—R. P., an eight-year-old male, was run over by an automobile on September 16, 1924. He was carried to a hospital in a state of shock, and with a fracture of the right iliac bone and crushed left second, third and fourth vertebræ. His first voiding was bloody but as his urine promptly cleared up, no attention was paid to this symptom. He was discharged on October 3, his only apparent impairment being a waddling gait. A fullness gradually developed on the left side. When I saw him on November 17, 1924, a radiogram showed the abdominal organs to have been pushed to the right of the midline. An attempt to pass a catheter to the left kidney failed; it entered the ureter a distance of 5 cm. and, after passing through the intramural portion, turned sharply to the left.

FIG. 3.—Pyelogram made 33 days after rupture of upper calyx. The sodium iodide passed through the rupture to the surface and then flowed around the kidney—beneath the capsule.

Operation and Results.—November 19, 1924, under gas, oxygen and ether anæsthesia, a lumbar incision was made and a sac was opened from which were evacuated three quarts of clear fluid containing urea. The retroperitoneal sac extended anterior to the pubic bone, and there were calcareous deposits on its walls. At the upper angle an apparently normal kidney could be felt behind the sac. A drainage tube was inserted and the incision closed. Phenolsulphonephthalein injected intravenously was recovered in small amounts from the drainage tube, most of the dye passing through the bladder. Later a cystoscopy showed indigocarmin coming from both ureters as well as from the drainage tube. An attempt was made to do a pyelogram through the fistula but this was only partially successful. The fistula healed in six weeks and the child is now in perfect health.

Comment.—At the time of the accident there was a rupture of the kidney pelvis. Eventually the walled-off urine increased in amount sufficient to interfere with the course of the ureter, causing it to form an acute angle, and the sac consequently increased enormously in size. When the contents of the pouch were evacuated so as to unkink the ureter the urine resumed its course through the normal channel.

CASE III (No. 360).—M. D., a forty-year-old male, on May 13, 1924, fell from a

hand-car a distance of three feet, striking his left side on a car rail. He voided blood-stained urine but as this cleared up in a few days its significance was apparently not recognized. The case was treated expectantly and the fever and leucocytosis that developed were attributed to a pneumonic condition as he had bloody expectoration. On June 9 he was transferred to the nearest city to a surgeon, as he had a tumor mass on the left side "the size of a small watermelon" and his leucocyte count was 20,000. A left lumbar incision was made by June Harris of Sacramento and "practically a gallon" of urine was evacuated and a drainage tube inserted. A cystoscopy done several days later by E. W. Beach showed no urine coming from the left kidney although a picture showed the catheter in the pelvis. The drain was removed and the wound healed promptly. Because of his refusal to return to work, his compensation and lodge sick benefits exceeding his normal income, he was referred by the insurance company to me for a complete urological examination. The urea and the phenolsulphonephthalein tests and the pyelograms showed a partial destruction of the left kidney. (Figs. 1 and 2.) There were no casts and no infection, hence no need of treatment. He returned to work on October 1, 1924.

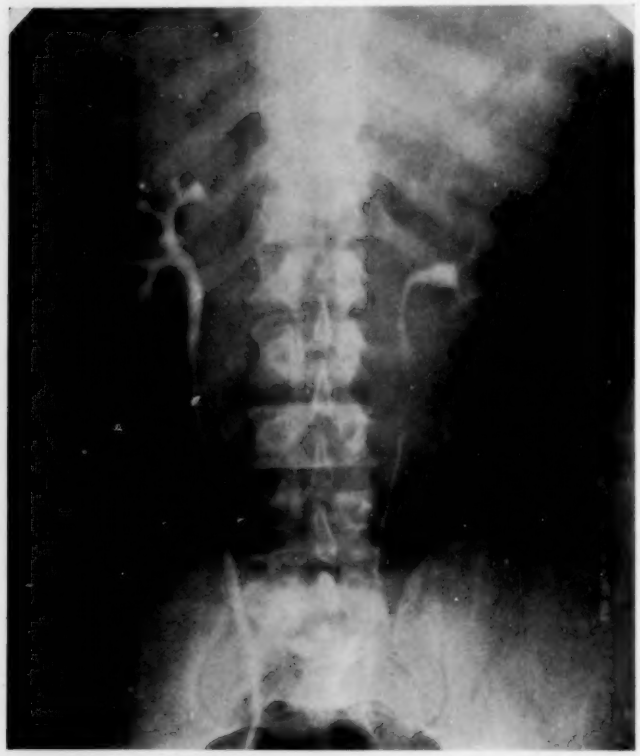

FIG. 4.—Same case as Fig. 3 but made one year later. Patient was in an upright position, hence there was no ptoses of the "half kidney," which was uninfected and had a reduction of 50 per cent. in function. (Courtesy of R. L. Rigdon.)

Comment.—A fall of three feet resulted in a traumatic rupture of the kidney with retroperitoneal extravasation of urine. Following the evacuation of the urine the kidney healed. As a result of the rupture and the consequent process of repair at least one-half of the secretory part of the kidney was destroyed. Instead of having two kidneys he has one and one-half kidneys, a reserve of 50 per cent. instead of 100 per cent.

CASE IV (No. 335).—J. H., a forty-five-year-old male, on June, 1, 1924, fell down a ship's hatch, a distance of twenty-five feet, striking on his right side and breaking a number of ribs. He was seen a few hours later by W. H. Winterberg and at that time voided bright red blood. This continued in decreasing amounts for thirty-three days. The bleeding was stopped by injecting, by gravity, with a twenty-four inch column, a 13½ per cent. sodium iodide solution to make the accompanying pyelogram (Fig. 3). The urine was uninfected and the function from the right side was 50 per cent. of normal. The patient's recovery was uneventful. Two months later a total phenolsulphonephthalein was done and 60 per cent. of the dye was excreted in one hour. His only complaint was that when he leaned over there was pain in the lower lumbar region. His prostate and seminal

vesicles were found to be very tender and to contain pus. A sacro-iliac belt was prescribed and he was given light work as a railroad porter; when his belt was tight he noticed no pain when stooping over to pick up two armfuls of grips. He began to indulge freely in the use of alcohol and some of his convivial friends told him that he needed treatment for his kidneys and that there was no need of working for he could draw pay as long as he was taking treatment. At this time he transferred his pain from the sacro-iliac region to the right loin, and a consultant advised a nephrectomy because of the pain. Two independent examinations made by eminent urologists showed uninfected urine, no casts, a destruction of one-half of his right kidney (Fig. 4), and with a phthalein output of 50 per cent. of normal from the damaged kidney. The kidney was in normal position, the pelvis not dilated and there being no objective evidence of the presence of pain, a nephrectomy or other treatment was not indicated, so he was ordered back to work.

FIG. 5.—Pyelogram and ureterogram made by injecting a fistula with Beck's paste. Traumatic rupture by external violence of a kidney containing two stones; abscess with fistula developed four months later.

Comment.—A subcapsular fracture of the kidney with hæmaturia persisted for thirty-three days and was stopped by a lavage of sodium iodide used to make a pyelogram. The pictures showed a destruction of the upper one-half of the kidney with the fluid around the kidney beneath the capsule. Pyelograms made one year later showed the upper calyx replaced by scar tissue, the surviving portion of the kidney being normal in all ways.

Since the kidney did not move with change of position, the ureter was not kinked or strictured, the pelvis was not dilated, there was no possibility of extra-renal adhesions (the extravasation being subcapsular) and no infection as indicated by the absence of casts, pus or organisms, there was no evidence that pain could exist, hence there was no compensatory disability. The patient's reserve is merely reduced 50 per cent. or one-half kidney. The pain was undoubtedly due to his prostatitis and seminal vesiculitis.

CASE V.—(Reported through the courtesy of Dr. John F. Pruett.).—M. L., fifty-one-year-old ship steward, in March, 1921, while making up beds struck his right loin against the corner of a berth. This was followed by severe local pain and fever. An abscess opened spontaneously at the site of the injury on July 15, 1921. He had become very weak and emaciated, had an afternoon elevation of temperature and a pulmonary examination disclosed showers of moist râles. However, repeated examination of the sputum, urine, and pus from the sinus were negative for tubercle bacilli. An X-ray showed stones in the right kidney. The bladder urine contained pus, B. coli and staphlococci. A cysto-

scopic examination revealed a bilateral renal infection; a normal phthalein output from the left side and only a trace from the right. The left pyelogram was practically normal. The sinus was injected with Beck's paste and found to connect with the right pelvis (Fig. 5). A successful nephrectomy was done and in July, 1924 the patient, who had returned to his home in Spain, wrote that he was in perfect health.

Comment.—A pyelogram and ureterogram from an injection of Beck's paste in a fistula that developed following a blow in the loin.

CONCLUSIONS

1. Of all the internal catastrophes a ruptured kidney treated under modern conditions offers the best prospect for a complete recovery.

2. Subcutaneous ruptures of the kidney heal without operation and with a function loss of approximately 50 per cent.

3. Before nephrectomy there should be an investigation as to the condition of the opposite kidney.

4. Bladder catheterization is to be avoided when possible because of the danger of infection.

5. Death never occurs from hæmaturia, *per se*, but blood clots in a bladder furnish ideal culture media for a catheter infection with ultimate exitus.

6. By saving a ruptured kidney we preserve a useful organ, even though its function is somewhat impaired by the cicatricial bands strangulating some of the parenchymatous elements of the organ and in case of subsequent destruction of the uninjured kidney the impaired one is able to do all of the work.

7. Subjective pain is not a compensatory disability in a healed ruptured kidney; (1) that is in the proper location, (2) does not move with change of position, (3) the pelvis is not distorted, (4) the function is reduced one-half, and (5) the urine contains no casts, pus or organisms.

8. Hæmaturia is not an indication for operation, being merely a signal while the hæmatoma is the measure of the lesion. An elevation of temperature may be due to absorption of blood and not to infection.

9. The kidney should be exposed when there is severe hemorrhage indicated by: (1) Falling blood pressure, (2) rising pulse rate, (3) decreasing hæmoglobin, and (4) an unsatisfactory general condition.

10. Primary nephrectomy should not be done except for a torn renal pedicle.

11. Conservative surgery consisting of the use of tampons or suturing should be the routine primary operative procedure.

12. The operative treatment of rupture of the kidney is secondary to the therapy of shock.

13. Five different types of cured kidney ruptures are reported:

a. Persistent board-like rigidity of left abdominal wall, accompanied by hæmaturia; cure followed expectant treatment.

b. Walled-off urinary extravasation (in a child) manifested itself two months after injury; treated by incisions and drainage of sac.

c. Walled off urinary extravasation (in adult) operated upon two months after injury because of fever, leucocytosis and tumor; treated by incision and drainage with a loss of only 50 per cent. function on that side.

d. A subcapsular rupture of the kidney treated expectantly with a loss of 50 per cent. function in the damaged kidney.

e. A rupture of an infected kidney containing stones with the formation of an external fistula that discharged pus but no urine. An injection of the fistula produced a pyelogram and ureterogram. Nephrectomy.

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TREATMENT OF OBSTRUCTIONS OF THE UPPER URETER AND EARLY HYDRONEPHROSIS*

By Charles H. Peck, M.D.
of New York, N. Y.

The procedure described in this report, first used on February 7, 1910, and first reported, before this Association, at the meeting in Rochester, Minn., in June, 1915, is simply one step in the technic of operations performed for the relief of obstructions of the upper ureter. It has, perhaps, its greatest sphere of usefulness in the types of obstruction associated with early hydronephrosis in which the dilated pelvis pouches downward, hooding over the pelvi-ureteral junction, and when tensely distended causing lateral, valve-like pressure at the pelvic outlet, sufficient in itself to cause complete urinary obstruction, whether it be the only cause of such obstruction (as in my second case, operated upon in October, 1911), or superimposed upon some other preëxisting cause, as in my first case, in which a small calculus acting as an intermittent ball-valve obstruction, was undoubtedly the primary cause of the hydronephrosis and pelvic pouching.

Fig. 1.—a. Lumbar incision. b. Hydronephrotic kidney; lines of excision for plastic on pelvis. c. Dilated pelvis showing valvular compression at pelvi-ureteral junction.

The procedure consists simply in passing a stiff ureteral catheter through a stab wound in the cortex of the kidney, down the ureter to the bladder, leaving it in place to act as a splint to prevent bends or kinks in the ureter, and especially at the pelvi-ureteral junction during the first few days after operation, while the kidney and ureter are becoming fixed in their new position, necessarily differing in some degree from its pre-operative position, owing to the lifting out and replacement of the kidney in the course of the operation.

*Read before the American Surgical Association, May 5, 1925.

With such a splint in place obstructive kinks or bends cannot occur, and by the time it is removed, after three to five days, they are unlikely to occur, as the fixation of kidney and ureter in position has been accomplished.

The splinting is, of course, only one step in the operative procedure, which must vary according to the lesion present, *e.g.*, removal of calculi, dilatation of high ureteral strictures, division of crossing vessels or fibrous bands which have caused obstruction, plication or plastic operation on a dilated pouching pelvis, nephropexy to fix a movable prolapsing kidney. We have met with all of these conditions in the short series of cases in which we have used the splinting operation.

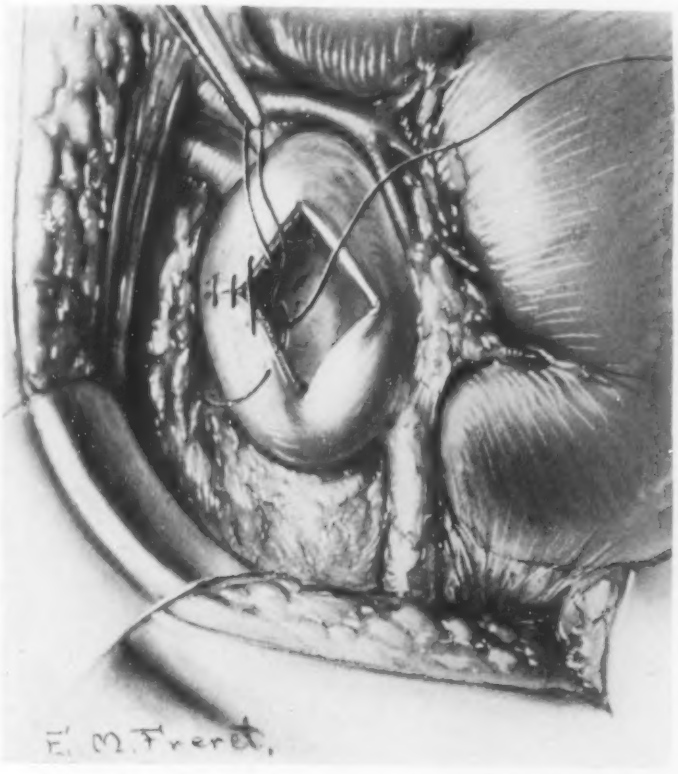

FIG. 2.—Suture of pelvis after excision of segment from posterior wall.

That it may aid in controlling pyelitis of a moderate severity, by improved drainage, is strikingly shown in one of our recent cases, in which it not only relieved the local condition of an infected and dilated pelvis, and thereby saved the kidney from further damage and probable destruction, but it also relieved a constitutional sepsis of several months' duration, which had been causing a marked debility and depression of the patient's general health.

CASE REPORTS

CASE I.—A man, aged thirty-five years, had been ill for several months with a colon bacillus infection of the right kidney. Constantly recurring pain, with elevation of temperature and leukocytosis, bladder irritability, loss of weight and general debility, persisted throughout the summer and autumn of 1923. The urine cultured larger numbers of colon bacillus repeatedly. Cystoscopy showed dilatation of the right kidney pelvis and an apparent incomplete obstruction of the upper ureter near the pelvis. The passage of bougies and attempts to irrigate the kidney pelvis failed to relieve the condition and it was feared that removal of the kidney was becoming inevitable. The proposed attempt to save the kidney, the uncertainty that it would prove feasible,

the chances of failure if the attempt were made, with the need of later nephrectomy, were all explained frankly to the patient, who gave free consent to an attempt to save the kidney, which might fail, or to immediate nephrectomy if it seemed advisable. The left kidney function was normal and it was not infected.

Operation, performed December 19, 1923. The kidney was much enlarged; the cortex thinned and lobulated, but there was still a good amount of comparatively normal kidney substance left. The pelvis was dilated; the upper ureter seemed constricted; its implantation was high and the pelvis hooded below, causing valvular obstruction. The perirenal fat was inflamed and adherent to the pelvic wall which had lost something of its normal thinness and elasticity. No calculi could be felt nor were any found later.

The question of nephrectomy was discussed, but it was determined to try to save the kidney by relief of the obstruction and better drainage. The pelvis was opened by a posterior incision and explored with the finger, the calyces were much dilated; there were no calculi. A ureteral catheter was passed through the opening down to the bladder; there was a tight stricture of the ureter near the pelvis which barely admitted the catheter. This was dilated with a metal probe to a normal calibre. A nephrotomy stab wound was made near the convex border of the cortex and a stiff ureteral catheter passed through it down the ureter to the bladder and left in place, its proximal end protruding from the main wound. An ovoid segment was then excised from the posterior wall of the pelvis, and the defect was sutured transversely to take up slack and obliterate the hooding. Nephropexy was then performed, and a small drain placed down to the posterior surface of the kidney.

Recovery was uneventful; the ureteral catheter was removed on the fifth day and the drain to the kidney two days later. The symptoms of pyelitis and the fever and constitutional symptoms began to abate at once, and improved steadily to complete recovery. A letter received, dated December 20, 1924, one year post-operative, says: "There has been no return of the old trouble; the cystitis has entirely disappeared; the urine still shows a few colon bacilli, about four to the field; my general health is splendid."

That a lasting cure with preservation of the kidney may result is illustrated by some of my early cases, reported in detail in the former paper (ANNALS OF SURGERY, August, 1915, vol. lxii, p. 252), *viz.:*

CASE II.—Operated upon in 1910. Marked hydronephrosis with hooded pelvis and small calculus. Reported April 1, 1925, fifteen years post-operative: "Perfectly well, never had any return of kidney trouble."

CASE III.—Operated upon October 25, 1911. Hydronephrosis with hooded pelvis and valvular obstruction. Reported perfectly well in the spring of 1924, thirteen years post-operative.

We have used the method in a variety of conditions not associated with a definite hydronephrosis, but due to some degree of ureteral obstruction, *e.g.,* a few cases of pyelitis which had resisted other treatment, dilating the ureter from above and placing the splint to insure better drainage, cases of recurrent, persistent kidney pain, in which it was impossible to demonstrate a definite pathology at the time of operation, but which were probably due to ureteral stricture or kinking. Cases of definite stricture or kinking; some caused by crossing vessels or bands with the ureter kinked by the descent of a movable kidney: In two recent cases of this latter type, symptoms began after a lifting strain and the attacks of pain persisted for several months until finally relieved by operation.

CASE IV.—A man, aged forty-three years, was admitted to the medical division of the Roosevelt Hospital, April 7, 1924, suffering from severe pain in the right lumbar region and persistent vomiting of ten days' duration, following a severe strain produced by lifting a heavy box of hardware. A careful workover showed no organic trouble in stomach; a pyelogram showed a slightly dilated right kidney pelvis; no calculi.

He was treated on the medical service for about six weeks with rest in bed, restricted diet, etc., with improvement of stomach symptoms, but lumbar pain persisted, especially when allowed out of bed.

He was transferred to the surgical division and operated upon May 20, 1924, the pre-operative diagnosis being nephroptosis following lifting strain, with ureteral kinking, probably at the pelvi-ureteral junction.

The kidney appeared normal except for moderate dilatation of the pelvis; there was no distinct hooding; the ureteral implantation seemed normal; there was no definite ureteral stricture; the kidney was somewhat ptosed and movable; no calculi were found.

Through a stab wound in the cortex a metal ureteral probe was passed down the ureter to the bladder, followed on its removal by a stiff ureteral catheter, which was left in place as a splint. The pelvis was not incised and no plastic operation was done; nephropexy was performed.

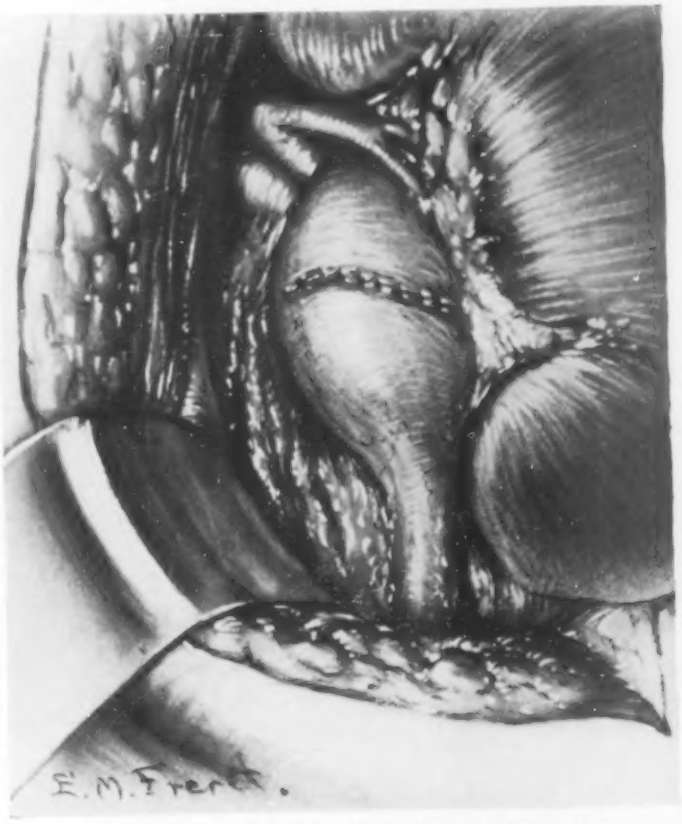

FIG. 3.—Suture of pelvis completed. Hooding and valvular compression corrected.

Convalescence was uneventful; the splint was removed on the fifth day and the patient was allowed out of bed on the twelfth day. After the ordinary wound pain and soreness had subsided there was no return of the lumbar pain nor of the vomiting. The patient has been kept under observation and has remained entirely well.

While the pathologic findings were so slight as to be, perhaps, open to question, we believe that this was a true case of beginning hydronephrosis due to kinking of the ureter.

The persistence of the pre-operative pain for a prolonged period, under careful observation and treatment, and its prompt relief following operation, seemed convincing proof that the pain was not a pure neurosis, a possibility which had been carefully considered during his pre-operative treatment.

CASE V.—A young woman, aged twenty-one years, married, of robust physique and good general health, suffered from severe attacks of pain in the right lumbar region dating back to December, 1923. The attacks were at first infrequent, but became more frequent and severe up to early in July, 1924. Cystoscopy then showed a slightly

dilated pelvis of the right kidney and an apparent obstruction of the upper ureter about 4 cm. below the pelvis. She was kept in the hospital a few days and discharged, as it was thought that the condition might improve without operation. The attacks continued all summer, and she was readmitted September 17, 1924. While resting in bed the pain was for the most part absent, but when out of bed or even sitting upright in bed the pain would recur. It was very severe at times, accompanied by sweating and sometimes by vomiting, never by fever or inflammatory symptoms. There was no pus in the urine; there was persistent, fairly marked tenderness over the right kidney. She was kept under observation without improvement until October 22, 1924, when operation was performed.

An aberrant artery, attached near the lower pole of the kidney, crossed the ureter about two inches below the pelvis and apparently caused constriction or kinking when kidney slipped downward. The vessel was double ligated and divided. The kidney seemed quite normal; the pelvis showed little dilatation and the ureteral implantation was normal. Through a stab wound in the cortex a stiff ureteral catheter was passed down the ureter to the bladder and left as a splint; nephropexy was performed, and the appendix was removed through a short intermuscular incision. It showed no definite pathologic change. Recovery uneventful; the splint was removed on the sixth day; she was out of bed on the fourteenth day and was discharged well on the twentieth day after operation. She has been kept under observation and has remained well, entirely relieved of her former pain.

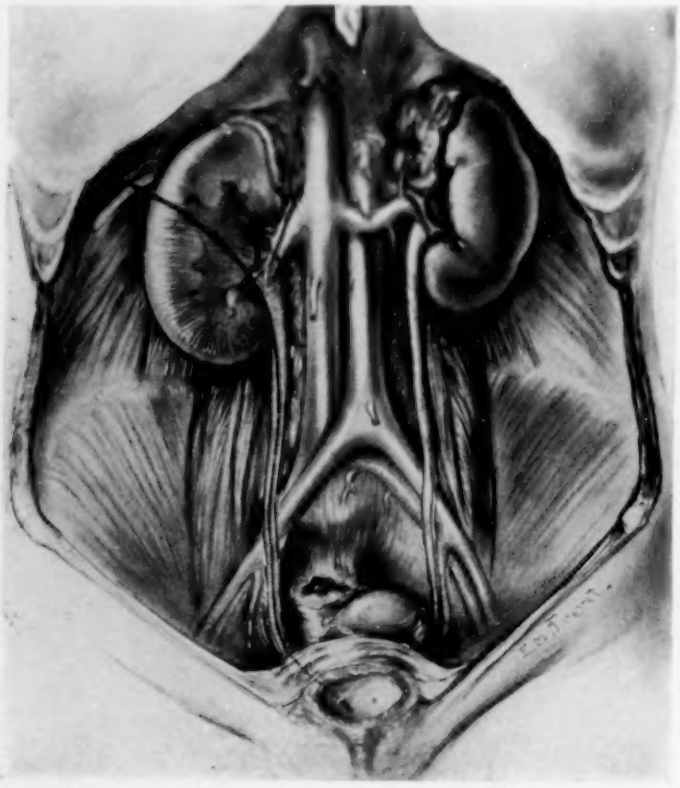

FIG. 4.—Ureteral splint in place; kinking at pelvi-ureteral junction or in course of ureter cannot occur.

It may well be commented that in this case splinting was an unnecessary adjunct to the technic of the operation and that division of the aberrant vessel was sufficient. We believe, however, that this additional insurance against subsequent kinking and partial obstruction is worth while even in this type of case.

We have performed the operation on twenty-six cases, in only four of which were calculi present. In two of these latter a dilated and hooded pelvis with valvular obstruction was present. In seven others there was definite

dilatation of the pelvis with valvular obstruction without calculi: three cases only had a definite pyelitis, two associated with hydronephrosis; one without pelvic dilatation: eleven cases had intermittent pain due to kinks or strictures of the upper ureter without definite dilatation of the kidney pelvis.

There were two deaths in the series, due to complicating conditions; one a case of Graves' disease in which the kidney operation should not have been performed; and one with multiple calculi and infection, in which death followed secondary nephrectomy for kidney suppuration. In no case which we have been able to follow has any relapse of the painful condition recurred nor has any subsequent trouble called for a secondary operation.

We grant that the procedure of splinting may not have been the most important factor in the relief of symptoms in all of these cases, and reiterate that its most important field of usefulness is in cases of early hydronephrosis with hooded pelvis and valvular obstruction at the pelvi-ureteral junction, or cases with a faulty implantation of the ureter causing obstruction and requiring a plastic procedure on the pelvis of the kidney. In such cases the prevention of a newly formed kink or valve is of prime importance, and splinting is an effective aid in such prevention. Had I used the method in the case operated upon in 1919, and cited in detail in my former paper, in which complete anuria due to valvular obstruction and pyelitis developed in the remaining kidney after a previous left nephrectomy, the result might have been a less unhappy one. The attempt to relieve the obstruction by a plastic operation on the pelvis failed and permanent urinary drainage through the lumbar wound resulted. It was the failure in this case that led me to adopt the method in subsequent operations.

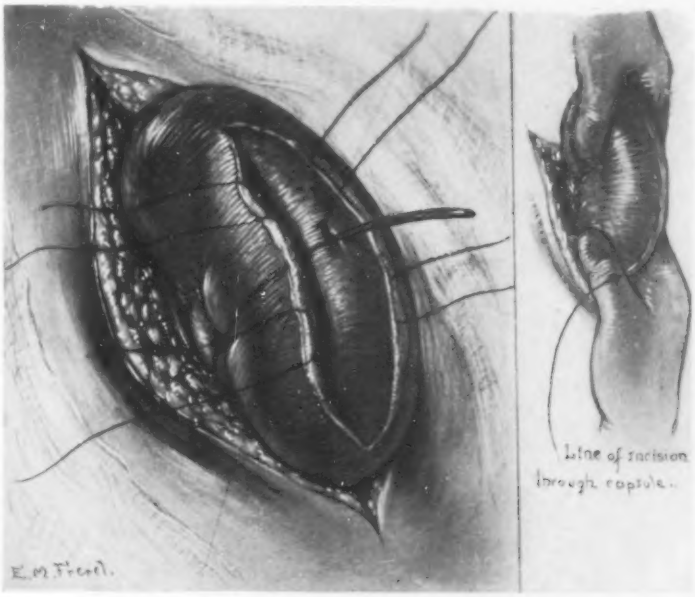

FIG. 5.—Sutures for nephropexy placed; catgut mattress suture tied 'round ureteral splint for hæmostasis.

In studying the pathology of this group of kidney cases, one is impressed with the fact that small, apparently insignificant, obstructive lesions or anatomical defects, for the most part easily dealt with in their early stages, can

soon cause serious damage and lead to complete destruction of a kidney if allowed to go untreated. We would also emphasize that kidneys in the earlier stages of hydronephrosis, even with fairly marked dilatation of pelvis and calyces and thinning of the cortex, may be well worth saving and should not be sacrificed simply because nephrectomy is easier for the surgeon and more certain to be followed by a brilliant immediate convalescence than a conservative operation.

Such a kidney saved may be of untold value should disaster befall its opposite neighbor at some future time.

SUMMARY

Splinting of the ureter is a useful adjunct to operative procedures for the relief of upper ureteral obstruction and early hydronephrosis, especially in the type with hooded pelvis and valvular obstruction at the pelvi-ureteral junction.

It is also useful in forms of painful obstruction, without dilated pelvis, usually in conjunction with probe dilatation of ureteral stricture and nephropexy.

In pyelitis with obstruction which has resisted conservative treatment, with or without a dilated pelvis, it may aid subsequent drainage enough to save a kidney threatened by damaging infection.

The procedure is simple, adds nothing to the operative risk and causes no damage to the ureter if the splint is removed within five or six days.

FRACTURES OF THE HEAD AND NECK OF THE RADIUS*

By Condict W. Cutler, Jr., M.D.
of New York, N. Y.

Among the bone injuries commonly met with, the fractures of the head and neck of the radius present several features of more than ordinary interest. While not so frequent in their occurrence as many of the other fractures, they are yet sufficiently numerous to warrant the study of the surgeon. The various opinions advanced with regard to the method of production of these injuries, the different types of treatment advocated by observers and the lack of uniformity in the results obtained give evidence of the possible value of further investigation. Over and above these considerations these fractures are of interest because of their importance to the patients, entailing, as they not infrequently do, permanently disabling injury to the elbow-joint.

Fig. 1.—Example of Class 1. Simple crack in the radial head.

The fifty cases which are the subject of this report have been gathered from the records of the Roosevelt Hospital and its Out-patient Department covering a period of ten years. They represent all of the instances of fractures of the head and neck of the radius which could be found during this period, with the exception of four, in which the records were not sufficiently complete to be of value.

Incidence.—The fractures in this group were nearly evenly divided between the sexes. Twenty-seven of the patients were males and twenty-three females. Study of the age incidence bore out the statements of Rabourdin[1] and other observers that these injuries are more common in adults and young adults than in children. The average age of the patients was 31. The oldest was 55, while the youngest was 6. The preponderance of adults may perhaps be better indicated by the statement that 28 of the patients were thirty years of

*Read before the Surgical Section of the New York Academy of Medicine, October, 1925.

age or older, while but 12 were under twenty. A further distinction, with respect to age, should be made in considering the fractures of the neck of the radius. Here, as emphasized by Speed,[2] the younger ages predominated, with an average of 18 years. Eliminating this group raises the average age for fractures of the head to 37 years, which places these injuries still more definitely in the adult category.

Etiology.—Considering this group of fractures of the upper radius with respect to the nature of the injury producing them, it was found that 20, or 40 per cent., had been caused by falls on the elbow. Four (8 per cent.) were

FIG. 2.—Example of Class 1. Simple crack in the radial head.

FIG. 3.—Example of Class 2. Fracture of the radius with separation of one fragment.

reported as following falls in which the forearm received the impact. Four were due to twisting injuries of the forearm, while falls upon the extended hand accounted for 10, or 20 per cent. In twelve the nature of the trauma was not reported. If the histories of these injuries are to be accepted as accurate, the findings in this group rather seem to support the views of Stimson [3] and of Rabourdin,[1] who mention direct trauma as the most frequent cause of this type of fracture, while Scudder [4] speaks of falls on the hand as being most commonly responsible.

Pathology.—In reviewing these cases with regard to their pathology they were found to group themselves most readily into four main classes. The least severe injury was the simple crack in the head of the radius without displacement of the fragment. Of these there were seven. The second class

comprised those cases, fourteen in number, in which there was a fissuring of the radial head with separation of one fragment. In the third class were grouped eleven cases in which the head was fragmented or split into two or more separated pieces. Fractures of the neck of the radius, of which there were fourteen, made up the fourth class. In four cases the exact pathology could not be ascertained.

Although it is well recognized that the patient is not likely to remember or report accurately the manner of receiving his injury, an attempt was made to secure as exact a history as possible on this point. It was hoped that an

FIG. 4.—Example of Class 2. Fracture of the head of the radius with separation of one fragment.

FIG. 5.—Example of Class 3. Fragmentation of the head of the radius.

attempt to show the relation of the nature of the trauma to the pathology might throw some light upon the mechanism of production in these fractures. The results were as follows:

Type of Injury		*Nature of Trauma*				
		Striking elbow.	Fall on hand	Twist of forearm	Fall on forearm	Unknown
1. Crack in radial head	(7)	3	1		3	
2. Separation of one fragment	(14)	7	3	1	2	1
3. Fragmentation	(11)	2	2	2	1	4
4. Fracture of neck	(14)	6	5			3

From the above tabulation it would appear:

1. That direct trauma was more frequently the causative injury in simple crack of the radial head.

2. That separation of one fragment occurred relatively frequently from direct trauma. The single fragment was fractured from the anterior lip in eight of the fourteen cases.

It is suggested that this chipping of the anterior lip may be caused by falls in which the forearm lies beneath the body in mid-pronation. In this situation the force of the blow striking the lateral aspect of the radial head, may be transmitted across the head of the radius against its area of firm contact with the lesser sigmoid cavity of the ulna, resulting in cracking off the anterior part of the head.

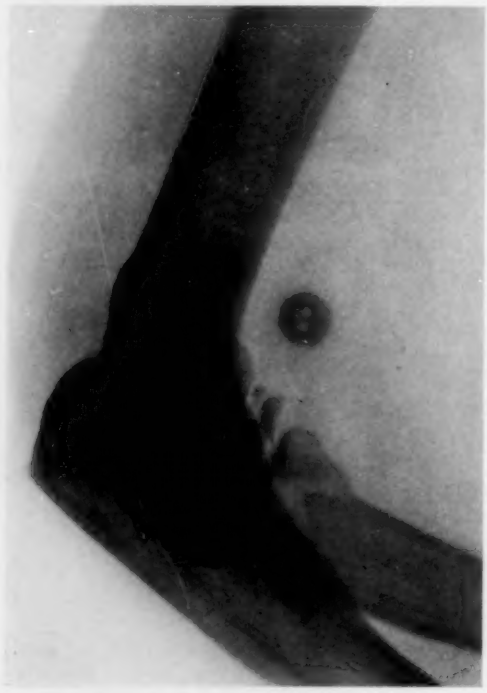

FIG. 6.—Example of Class 3. Fragmentation of the head of the radius.

3. That in fragmentation of the head, each of the usual accidents played about an equal part. Of four cases where wide separation occurred with apparent rupture of the orbicular ligament, two were caused by falls on the extended hand and two by twisting injuries of the forearm.

4. That direct and indirect violence were about equally responsible for fractures of the neck of the radius. Of the eight children under sixteen years of age who suffered this injury in the present series, four each were ascribed to direct and to indirect trauma.

A certain relation is suggested here between the fact that fractures of the neck of the radius are more common in children and the observation that direct trauma is so frequently the cause of this injury. It seems reasonable to suppose that in children a fall on the extended hand is more likely to cause injury at the line of least resistance above the humeral condyles than in the upper radius. In the adult the head of the radius, no longer partly cartilaginous but inelastic, cancellous and with a relatively thin shell of cortex, is more likely to be split or shattered by the upward thrust against the capitellum resulting from indirect trauma. Thus, while indirect violence seems more likely to cause radial head injuries in adults than in children, direct violence remains a competent cause of fractures of the upper radius in both.

Review of the above analysis of pathology with reference to character of injury would seem to indicate that it is impossible to predicate the type of lesion definitely from the history of the trauma. Direct and indirect trauma

were apparently capable of producing any of the four classes of fracture. Twisting injuries of the forearm, or falls with the forearm twisted, probably involving the element of forced abduction, appeared as causative factors in two of the classes in this group, namely those in which there was separation of one or more fragments of the head. It was of interest to note also, that in the more severe injuries (fragmentation of the head and fracture of the neck

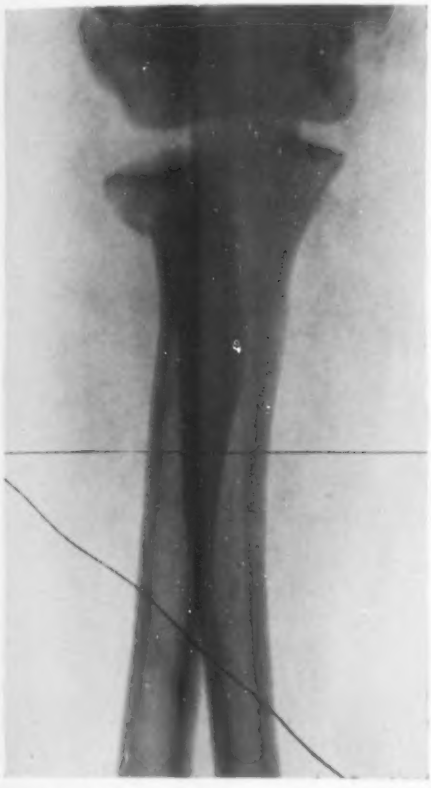

FIG. 7.—Example of Class 4. Transverse fracture of the neck of the radius.

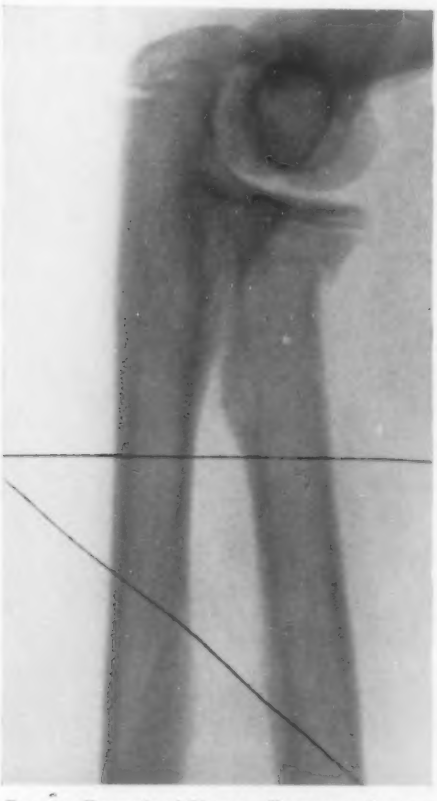

FIG. 8.—Example of Class 4. Transverse fracture of the neck of the radius.

with marked displacement) the ratio of indirect to direct trauma was greater than in the less severe cases.

Complications.—The fact that falls on the extended hand and twists of the forearm are likely to be productive of the more serious damage is further indicated by the complications which occurred in this group. Of these there were six. Two were posterior dislocations of the ulna with fracture of the neck of the radius, due to falls on the hand. One was a compound dislocation of the ulna with fragmentation of the radial head from a twist of the arm. One was a posterior dislocation with fracture of the olecranon and transverse separation of the head from a fall on the elbow. One was a fracture of the coronoid with an anterior chip broken from the head of the radius, due to a fall from a height. In this case a fracture of the skull further complicated the picture,

and a definite history of the mechanism was not obtainable. The remaining case, a fracture of the neck of the radius, was complicated by a fracture of the upper third of the ulna in a young child. Here also the history of the injury was not satisfactorily elicited.

Symptoms and Signs.—The symptoms and signs presented by these injuries of the upper radius showed a considerable degree of uniformity. Pain, referred to the elbow region, particularly at the outer side, was complained of in all cases except four. These four came for the relief of a disability result-

FIG. 9.—Transverse fracture of neck of radius in child of eight. Picture taken three years after complete removal of radial head. Complete restoration of function, shows enlargement of lesser sigmoid to form new radio-ulnar articulation. This case was complicated by fracture of upper third of ulna. (Case R. L., No. 1441.)

FIG. 10.—Transverse fracture of neck of radius in child of eight. Picture taken three years after complete removal of radial head. Complete restoration of function, shows enlargement of lesser sigmoid to form new radio-ulnar articulation. This case was complicated by fracture of upper third of ulna. (Case R. L., No. 1441.)

ing from injury some time previously. Disability was a uniform complaint, having been noted in all the cases of the group, both recent and old. This disability involved characteristically all motions at the elbow, flexion and extension as well as pronation and supination, varying somewhat in degree according to the severity of the injury. In the few cases in which it was noted, the attitude assumed by the patient was that of mid-flexion of the elbow, with the arm supported. Swelling, in the cases seen within twenty-four hours after injury, occurred in about two-thirds of the patients and was noted as being usually diffuse about the elbow.

Ecchymosis was less common, being observed in but nine of twenty-two recent cases. Bony irregularity was noted in but four of the cases seen soon after injury. Each of the four had suffered transverse separation of the head from the shaft with rather marked displacement. With the exception of the four old cases mentioned as applying for relief of disability, and the one of compound fracture-dislocation, all of the cases of the group showed tenderness. Direct and indirect tenderness were present together in forty-three instances. Direct tenderness, over the head of the radius proved to be the most reliable of all the signs, appearing as the only localizing evidence in three of the cases observed. Failure of the head to rotate with the shaft was noted in two cases of fractures of the neck. No observation was made, or at least none was recorded, of the presence of abnormal lateral mobility, one of the physical signs mentioned by Stimson.[3]

FIG. 11.—Fragmentation of the head of the radius in boy of twelve. Treated by removal of fragments. Picture shows condition three years after operation. Exostoses and bony proliferation marked. Slight limitation of flexion and pronation. (Case H., No. 1442.)

Diagnosis.—In view of these findings the diagnosis of a typical case of fracture of the head of the radius rests upon a history of a fall on the hand or the elbow, or a twisting injury of the forearm, followed by pain about the elbow, limitation of supination and pronation as well as flexion and extension; showing some swelling about the elbow, referring indirect tenderness to the region of the radial head and with direct tenderness elicited in the same region. If, in addition, failure of the head to rotate with the shaft can be demonstrated, or if bony irregularity of the head varying from its normal relations can be felt, separation of the head may be diagnosed. The X-ray picture is confirmatory. Emphasis should be laid upon the necessity of making the exposures in two directions. If this is not done a number of cases in which the head is merely cracked will fail of proper diagnosis.

The X-ray findings in the cases of this group have been indicated in the discussion of the pathology. In general they showed a considerable variety in the injuries sustained, even in each of the four main classes into which the group has been divided. For example, in the class of crack in the radial head with displacement of the fragment, several of the cases showed but slight

displacement of the separated piece, while in one instance (as proved at operation) the fragment lay in the flexor muscles completely outside the joint. Similar variations in degree of fragmentation and amount of displacement of the radial head occurred in classes three and four, respectively, But one case of impacted fracture of the neck was observed, although Thomas [5] mentions this injury as being frequent. Another point of interest was noted, in that, although there were eight cases of separation of the radial head in children, only two were epiphyseal separations, the others being frank fractures of the neck, distal to the epiphyseal line.

FIG. 12.—Fragmentation of the head of the radius in boy twelve. Treated by removal of fragments. Picture shows condition three years after operation. Exostoses and bony proliferation marked. Slight limitation of flexion and pronation. (Case H., No. 1442.)

Prognosis.—Considering the variations in pathology observed it is obviously difficult to lay down a general rule of prognosis for the composite group of fractures of this type. The prognosis in each case must take into account such factors as the type and extent of the fracture, the presence or absence of complications, the age of the patient and the method of treatment employed. Study of this particular group of cases indicates that the best results may be expected in the less severe injuries where the head is merely cracked or where one fragment is displaced, while in fragmentation and fracture of the neck, particularly where there is much displacement, the prognosis is less favorable. Where the picture is further complicated by the presence of other fractures in the region or by dislocation, the prognosis is least favorable. Here, as in other types of fracture, the younger ages offer the better prospect of satisfactory recovery. As important as any of these factors in determining prognosis is the question of treatment. Scudder [4] emphasizes this in saying that with proper treatment uncomplicated fractures of the head or neck of the radius should result in union and normal function.

Treatment.—Yet as to what constitutes proper treatment in these cases the opinions of the various writers differ. Scudder [4] takes the somewhat conservative view that fractures without much displacement are amenable to treatment by immobilization in right angle position until union occurs, followed by mobilization. Where the fragments are widely separated, or where non-

union, adhesions, callus, or displaced fragments impair the usefulness of the arm he advocates operation. Mouchet,[6] referring particularly to fractures of the neck, feels that immediate movement and massage is indicated without attempt at reduction. Rabourdin,[1] on the other hand, feels that non-operative treatment is only applicable in cases where there is a fissure of the radial head, and advocates the removal of fragments and an early cleaning of the joint in all others. Jones[11] recommends excision when the head is displaced with fracture, and when supination cannot be obtained. Hitzrot[7] cites 13 of 15 cases which, without operation, showed loss of one-half the normal rotation, while Thomas[8] mentions 12 of 18 unoperated cases which showed ankylosis, non-union, or impaired function. Estes[9] states it as his opinion that resection is too seldom practiced, while Wilson and Cochrane[10] believe that the end results are often surprisingly good without operation, and recommend the closed method of treatment as best in dealing with cases which show either only slight displacement, or extensive comminution.

FIG. 13.—Case Lu., No. 8468. Fragmentation of the head of the radius in a boy of nine. Immobilization in flexion for ten days, followed by sling and baking and massage.

In the group of cases under consideration the treatments used in the various classes were as follows: All of the seven cases of simple crack in the radial head were treated by the closed method. Of those showing displacement of one fragment of the head six had operative treatment and eight did not. In eight of those with fragmentation the fragments were removed, while three were not operated upon. The radial head was removed in eight of the cases with separation of the head, while no operation was performed in six. Four of the cases in which operation was done were old cases in which much limitation of motion was present. One of these showed much callus and practically ankylosis following marked fragmentation of the head, while the other three were complicated by dislocation of the ulna. Eighteen of the unoperated cases were treated by placing the arm in supination and acute flexion for from five to twelve days, followed by the use of sling and baking and massage, active and passive motion. The remainder were treated

with rest in a sling from the start. Reduction of a displaced fragment (separated head with forward displacement) was attempted twice, once with success.

It is felt that the treatment of these conditions in the flexion position with supination (where the closed method is used) has certain advantages. In general, the ability to secure flexion and supination indicates that the fragments are in such position as to permit of this range of motion, and that they may be retained there, with at least the possibility of union. Also, as in other fractures of the elbow, this position obtains the early restoration of these important motions, which otherwise are often difficult to regain. In the class of radial head fractures with a simple crack, this advantage is sufficient to warrant the use of the method. In fragmentation or separation of the head the failure of an attempt to secure this position by reason of bony interference may well be the indication for excision of the fragments, as full and useful function of the arm is not then otherwise obtainable. If flexion and supination can be secured, union and restoration of function are possible.

FIG. 14.—Case Lu., No. 8468. Fragmentation of the head of the radius of a boy of nine. Immobilization in flexion for ten days, followed by sling and baking and massage.

Results.—In tabulating the results of treatment in the cases of this series the following criteria are used: Good—complete restoration of function; Fair—slight limitation of one or more motion; Poor—marked limitation of one or more motion. The early results, noted at the time of discharge or of cessation of treatment, were as follows:

Class of Injury.	*Excision*			*Non-operative*		
	Good.	Fair.	Poor.	Good.	Fair.	Poor.
1. Crack in the radial head				5	2	
2. Separation of one fragment	2	3	1	4	3	
3. Fragmentation	2	6		1	2	
4. Fracture of the neck	1	5	2	3	2	1

The report of late results, secured by examining the patients a year or more after discharge, is less complete, but indicates in a general way what may be expected in the treatment of these injuries.

Class of Injury	*Excision*			*Non-operative*		
	Good.	Fair.	Poor.	Good.	Fair.	Poor.
1. Crack in the radial head				5	1	
2. Separation of one fragment	5	1		2		
3. Fragmentation	3			1		
4. Fracture of the neck	3	2		5	1	

Upon the basis of these results alone it would be manifestly impossible to make a satisfactory comparison between the operative and non-operative methods of treating fractures of the head and neck of the radius. The figures

FIG. 15.—Result in case shown in Figs. 13 and 14.

FIG. 16.—Result in case shown in Figs. 13 and 14.

do indicate, however, that the closed method of treating simple cracks of the radial head produces satisfactory results. As regards fractures of the other three classes it can only be said that each method has yielded some results that were good, as well as a few that were imperfect. It would seem, therefore, unwise to advocate excision in every case of fragmentation or fractured neck. This is especially true since the operative procedure itself is not free from danger. The technical difficulty of locating and removing a single displaced piece of the head, or of finding and extracting all pieces in a multiple fragmentation may be considerable. In one case of this group, at least, not all of the fragments could be extracted. In addition, three of the cases operated upon suffered infection of the wounds, resulting in delayed convalescence and in impaired results in two. Considering also the fact that should the closed method fail of good results in appropriate cases recourse may still be had to

surgical removal of the fragments, it would seem best to treat these injuries without operation except where definite indications for removal are present. Such indications would appear to be: 1. Such displacement of a fragment or of the whole head as would interfere with full joint motion. 2. Irreducible complicating dislocation of the radius or ulna or both. 3. Mal-union, ankylosis or impaired motion in old cases.

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LATE RESULTS IN TREATMENT OF SIMPLE FRACTURE OF THE FEMUR IN ADULTS*

By Roderick V. Grace, M.D.
of New York, N.Y.

The numerous papers now appearing in the literature regarding fracture of the femur in adults, indicate the renewed interest in this subject as well as a marked diversity of opinion regarding the methods of treatment to be used. In this analysis of cases treated in the First Surgical Division of Bellevue Hospital no attempt is made to recommend any standard method of treatment, but by a critical review to ascertain the strength and weakness of our present methods of care so that we may approach the best anatomical and functional results in the highest per cent. of cases, and at the same time shorten the time of disability. This analysis deals with the treatment of 47 patients, all adult cases.

Age: 15–20 years, 5 cases, or 10+%. 40–50 years, 11 cases, or 23%.
20–30 years, 13 cases, or 27%. 50–60 years, 8 cases, or 17%.
30–40 years, 8 cases, or 17%. 60–70 years, 2 cases, or 5%.

Sex: 34 males. 13 females.

Site of fracture: Upper third, 14 cases. Middle third, 23 cases. Lower third, 10 cases.

In this analysis no case has been considered in whom the follow-up was less than one year.

The patients are grouped according to the methods used, into two general classes: A. Operative cases, 12. B. Non-operative cases, 35. This latter group is subdivided into cases treated by: 1. Skin traction. 2. Skeletal or caliper traction. 3. Plaster case.

Operative Group.—The indications for these operations may be grouped under two heads: 1. Failure of reduction. 2. Non-union.

Failure of reduction, eleven cases, reasons for: *a.* Tissue interposition, 2 cases. *b.* Skin traction failure to overcome overriding, 9 cases.

In these last skin traction failures, the patient showed by X-ray and actual measurement, overriding varying from 4 to 8 cm. One must be struck by the fact that in only two cases of this series, many of them very severe fractures, was tissue interposition present as a bar to satisfactory reduction. The larger group of 9 cases in which reduction failed after skin traction shows the limitations of this device, especially in cases in which the overriding is more than 4 cm.

Results of operative methods: operative failure, one death (anæsthetic); one amputation for streptococcus hæmolyticus infection; one non-union.

In the remaining 8 cases an excellent anatomical and functional result was obtained. These cases showed bony union occurring in from six to eight

* Read before the New York Surgical Society, October 28, 1925.

weeks. The shortest time of disability was three months, the longest time was ten months and the average time was six and one-half months.

Out of 9 plated cases, it was necessary to remove the plates in 4. In two of them, pain was the persistent symptom which caused the patient much distress. It was relieved by removing the plate. At operation in each of these cases there was some evidence of loosening of the screws and plates. The removal of the plates was followed by healing without incident. In the third and fourth cases the plate was removed on account of non-union at the site of fracture.

A résumé of the three operative failures follows:

Case I.—J. W., fifty-nine, male, lower third. Twenty-four hours after admission, calipers applied, 20 pounds. The 3 cm. overriding was overcome, but lower fragment still remained displaced backward. Two efforts were made under general anæsthesia, ether, to reduce without success. During this period, five X-rays were taken within thirteen days, when an open reduction was done.

Operation.—Open reduction, Lane plate.

Pathology.—Cause of failure was tissue interposition.

Post-operative Course.—Wound healed per primum. In three months he showed firm union with a large callus and perfect position. Follow-up six months; a large callus and firm union. Flexion to 75°, extension 180°.

Follow-up, one year: He complained of pain in fracture and gradual increasing disability. Readmitted 15 months after first operation. Operation: Removal of Lane plate. The outer plate was fractured. The screws were loose. Fibrous union was present, but there was slight abnormal mobility. The callus was very large; the deep tissues were unhealthy looking. Uninterrupted recovery followed. On account of the slight abnormal mobility, Thomas caliper splint was applied. Since this time, up to the present, the patient has shown increasing abnormal mobility at site of fracture. The function at the knee is very good. It is necessary for him to walk with a Thomas splint which prevents abnormal mobility at his fracture. It is impossible for me to say why this patient should have developed non-union after such a long period of time. Wassermann reaction was repeatedly negative.

Case II.—H. S., thirty-seven, male, site of fracture, middle third. Patient was admitted eight days after fracture which was transverse with 5 cm. overriding. Twenty-pound calipers applied and overriding overcome in twenty-four hours. There was over-separation of about 1 cm. Therefore weight was reduced. Five weeks later, there was no evidence of union, therefore open operation was done and Lane plating.

Gross Pathology.—The fracture ends were eburnated. There was no evidence of callus formation. The medullary cavity was not obliterated; the bone ends lay in the middle of a large cyst with smooth lining containing about one and one-half pints of bloody fluid. The crureus muscle was lacerated and degenerated.

Microscopic Pathology.—Specimen shows muscle, dense connective tissue and hemorrhage. The connective tissue is lined on one side with flat connective-tissue cells. This is evidently the inner surface of the cyst. The section shows slight round-cell infiltration.

Course.—Wound healed per primum. At end of second month, plate appeared loose. There was union present, but it was not very firm. A second operation, two months after plating was done and Lane plate removed. A moderate amount of callus was found to be present, but there was slight mobility at the site of fracture. The wound healing was complicated by presence of a hæmatoma; microscopically, there were pus cells present in smear of the wound. The culture showed staphylococcus aureus. The wound healed by granulations in four weeks. Two Wassermanns taken at this time were negative. Three and one-half months after this there was apparently firm union and no mobility.

Patient wore a Thomas caliper splint. Follow-up six months later, no union. Readmitted for third operation, namely, bone transplant. Third operation: transplant graft inlay. Patient developed a severe streptococcus hæmolytic infection locally. Amputation was necessary. He had three transfusions; recovery followed. Specimen at operation showed dense scar tissue. There was no evidence of bone formation. In one area there was a small amount of calcium salt present.

Comment.—In five weeks following admission, patient had six X-rays. In eight weeks, following first operation, he had four X-rays, and in the two following months, two more X-rays. This with failure of immobilization before admission to the hospital may have been factors in preventing bony union.

Case III.—Open reduction for transverse fracture of middle third. Patient died on table. Death probably due to anæsthesia during operation.

Comment.—These results, even though of a small series, bring out the advantages and disadvantages of open operation. The excellent anatomic and functional result when obtained shorten the time of disability greatly. With the increasing success in the treatment of fractures of this type by calipers, the number of open operations has been considerably diminished and will probably be limited mostly to those cases in which reduction is prevented by tissue interposition and in cases showing mal or non-union.

Skin Traction Cases.—This was the earlier and more conservative method of traction suspension used. Adhesive was the material in all the cases, 23 in number. Ten cases, or 43 per cent., were successfully treated by this method alone. In 13 cases, or 57 per cent., this method was found to be a failure, and reduction was obtained either by skeletal traction or open operation. In skin traction, the weights applied vary from 15 to 25 pounds. In the 10 successful cases, 6 showed 2 cm. overriding or less; 3 showed 3 cm. overriding or less, and 1 showed 4 cm. overriding. In only two of these 10 cases was the overriding reduced by more than 2 cm. In the remaining 8 cases, there was very little change in the measurements after a reasonable period for reduction had elapsed. In these successful cases, bony union occurred from seven to ten weeks, the average being eight and one-half weeks. The disability ranged from six to thirteen months, the average being eight months plus. The average overriding in these cases on discharge was 2.5 cm. In the thirteen unsuccessful cases, the reason for the substitution of another method was the failure to reduce the overriding to less than 3 cm. In one case, the adhesive irritated the skin so badly that it had to be removed and a plaster case substituted. Of the remaining 12 cases, eight were treated by open reduction and four by the insertion of calipers. The objections to the method of skin traction are patent in view of the fact that usually the amount of shortening which a patient can have and obtain a satisfactory functional result, without limping is 2.5 cm. It is necessary that the overriding be reduced to at least this amount and since this is not usually accomplished, it restricts the use of skin traction to that smaller group in which the fragments are in good position and the overriding less than 2.5 cm., presuming the skin can bear the adhesive material.

In the unsuccessful cases treated by skin traction, the larger number were brought to a successful result by open reduction. This was at a time when

our experience with calipers was limited. With our knowledge and experience in the use of calipers we now feel that this latter method would have sufficed in many of these cases and have been the method of choice.

Caliper or Skeletal Traction.—This more recent method of treatment we think to be the method of choice in the majority of cases. The theoretical objections offered against this method are: (1) Anatomic misplacement into joint, epiphysis or neighboring soft parts. With reasonable care and experience, misplacement should rarely happen. In our series each of these misplacements has occurred. They were quickly recognized and reintroduction of the tongs effected without any disability. (2) Wound infection. This will be discussed later.

The advantages claimed for this method of treatment are:

(1) It overcomes overriding in all cases quickly unless there is tissue interposition and tends toward anatomic reposition of the fractured ends.

(2) It allows massage and motion during the time of traction, thus diminishing the muscle atrophy and stiffness of the adjacent joints.

(3) It promotes the comfort of the patient.

(4) There is a relative ease of care of the fracture after application.

(5) It serves to correct the displacements of fractures during the course of their repair up to the time of bony union.

The calipers used are of the dull type. Under local anæsthesia they are inserted slightly into the femur just behind the condyles. The traction weights are immediately attached. The position of the calipers is checked up by X-rays.

Caliper Traction.—Caliper traction; number of cases, 18. In 4 of these it followed failure of skin traction to overcome overriding. In the remainder it was used primarily. There were two misplacements, both of which were recognized by X-rays. In one case a caliper point was placed at the epiphyseal line. In another case a caliper point becoming loose, slipped into the joint. No untoward results followed correction of these misplacements.

Overriding.—The average in these cases varied from 4 to 8 cm. In only one case did caliper traction fail to bring the bony ends into a position judged to be satisfactory. Operation later showed this failure to be due to tissue interposition. Therefore, barring this complication, in our experience, this has been the most successful method of overcoming even the most extreme overriding. The weight applied varies from 15 to 25 pounds in the majority of cases. This will as a rule cause a satisfactory reduction. The check-up X-ray should not be taken before 48 to 72 hours has elapsed. In a few cases, overweighting may result in separation of the fragments. This overseparation if allowed to continue may be a factor in the delayed or non-union cases. Bony union occurred in all but two cases; one of these showed muscle interposition at open operation. The other showed non-union five weeks after admission with eburnated bones lying in a cyst. Bony union occurred on an average of eight weeks. The average time of disability was nine and one-half months. Follow-up results on these patients show that in all but four cases there was

a satisfactory anatomic and functional result. Of the other four cases the anatomic result was good, but there was either slight limp present or the function was restricted to 90° of flexion.

Wound Healing.—Many of the wounds showed marked local inflammation. This probably involved soft parts and periosteum with cortex to a lesser extent. In several cases, cultures of inflamed wounds showed the presence of staphylococcus aureus. The inflammation usually subsides with the withdrawal of the calipers. The average time for the wounds to heal was two to four weeks after removal of the calipers. The temperature varied from normal to 100½° during time of caliper traction. Some of the cases, however, show no febrile reaction. The inflammation is generally superficial in the bone, if it should be present there.

In one case the patient showed a sinus which persisted for five months and then healed. In another case the patient, after discharge, was subjected to curetting of the bone at another hospital. This temporarily lighted up his wound.

The sinus failed to heal until eighteen months had elapsed when patient discharged a small sequestrum. Redness and swelling of the soft parts is no indication for the removal of calipers. These local signs are purely temporary. The spreading of the infection and persistent pain with a positive wound culture necessitates their removal. During this method of treatment the care of the muscles and adjacent joints can be very efficiently carried out. With the adjustable knee piece attached, early motion may be instituted, and thus the extreme stiffness of adjacent joints may be obviated. In several cases seen by us, severe overriding has been overcome as late as the eighth week. In this type of case, X-ray has even showed large amount of callus present at the fracture site. In such cases, weights may be steadily increased within reason, until the overriding is overcome. As an extreme example, a weight of 60 pounds was used on one of these patients for a short duration, which overcame overriding of 6 cm., after which the weight was immediately reduced.

The relative comfort of these patients in moving about in bed and the ease in their nursing care are also factors that recommend this form of treatment. Old age is no contra-indication. Several patients close to seventy years have been treated by this method. We believe the principle of skeletal traction to be a sound one. The unsuccessful results that are mentioned after its use do not alter the worth of this principle.

Plaster case, 6 cases. Of these two refused traction and plaster case was applied. One had also fracture of both bones of leg. One had also fracture of pelvis. Two had transverse fracture with no displacement. The average disability was eleven months; the shortest was six months and the longest eighteen months. The relatively small number of cases treated by this method make conclusions hazardous.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held October 28, 1925

The Vice-president, Dr. Frank S. Mathews, in the Chair

TRAUMATIC RUPTURE OF HYDRONEPHROTIC KIDNEY

Dr. De Witt Stetten presented a boy, age nine years, who was seen by him about noon of March 27, 1925, with a history of having been struck in the lower abdomen, on the back and thigh. He immediately afterwards complained of severe pain, but did not vomit or void. The point of interest in the past history is that the child since the age of one and a half years had had frequent attacks of abdominal pain with vomiting. This pain was referred largely to the right upper abdomen. These attacks usually lasted about two days, during which time there was rather severe pain, and then for the following week there would be slight abdominal discomfort. During these attacks there was never fever nor any urinary symptoms. These attacks were variously diagnosed as cholecystitis and appendicitis. They have been less frequent in the past few years, the last having been seven months before the present illness.

When seen the child was very irritable, but had a good color and did not look collapsed. Pulse was 60. He was lying with his thighs drawn up on his abdomen. There was distinct sensitiveness and some rigidity in the right upper quadrant, but not elsewhere in the abdomen. The following day patient seemed quieter but had begun to vomit and was passing somewhat bloody urine. The vomiting was rather continuous and each specimen of urine seemed to be a little more bloody than the last. Patient then became slightly drowsy and the pulse and temperature began to rise a trifle. About thirty hours after the injury the temperature was 101°, pulse 116. The last urine passed was very bloody. There was definite sensitiveness and rigidity in the right hypochondrium and in the entire lower abdomen, but no evidence of a mass or urinary extravasation. On the suspicion that he was suffering from either a rupture of the right kidney or of the bladder, he was admitted to the Lenox Hill Hospital. A cystoscopy showed a profuse bleeding from the right ureteral orifice, with clear urine coming from the left ureteral orifice and no evidence of bladder injury. With a provisional diagnosis of traumatic rupture of the right kidney following a blow on the abdomen, about thirty-five hours after the injury through a right Mayo incision the perirenal space was opened. This was found filled with at least one pint of clotted blood and extravasated urine. The right kidney was a typical hydronephrotic organ with a much dilated pelvis and calyces. A fibrous strand probably containing a vessel ran between the pelvis and ureter, producing a kink at the point of junction. The ureter was somewhat thickened and friable. On the anterior surface of the dilated pelvis was an irregular jagged tear about one and a half inches in length running up into the kidney substance. From the edges of the tear, especially where this extended into the kidney, there was marked oozing. A typical nephrectomy was done, including about two inches of the ureter below the pelvis.

The specimen presented a typical hydronephrotic kidney with a markedly dilated pelvis and calyces and a very thin cortex varying in thickness from ¼ to ⅜ inch. The wall of the pelvis was somewhat thickened and the ureter was also somewhat thickened, dilated and rather friable. There was definite kinking at the junction of the pelvis and ureter. There was no gross evidence of tuberculosis. There was an irregular jagged tear about one and a half inches in length on the anterior aspect of the dilated pelvis running into the kidney substance. Microscopical examination showed the typical lesions of hydronephrosis with no evidence of tuberculosis.

Patient's convalescence was entirely uneventful. Since the operation he has gained seven pounds in weight and has had no recurrence of his attacks of right-sided abdominal pain.

An analysis of this case justifies the opinion that this boy suffered from a congenital hydronephrosis due to an anomalous vascular strand producing a kink at the junction of the pelvis and ureter, and that his previous abdominal attacks were due to an over-distention of the hydronephrotic kidney. It is fair to assume that there was moderate distention at the time of his accident, so that a relatively slight trauma was capable of producing the rupture.

EXTRAMEDULLARY TUMOR OF SPINAL CORD SIMULATING ABDOMINAL MALIGNANCY

Dr. De Witt Stetten presented a man, age forty-four years, who was first seen on February 3, 1922. He gave a history of an old, thoroughly treated lues acquired about twenty-five years ago. His wife has no children, but had two miscarriages at about four months. In January, 1921, he had an attack of what was diagnosed as sleeping sickness and was in bed seven weeks. His present illness began six months ago with a persistent deep pain in the right hypochondrium radiating to the back. He believed he was jaundiced and vomited occasionally. He lost thirty-five pounds in weight. His main difficulty was that he could not lie down and had practically not been in bed during the entire period. He slept fitfully in a chair or standing in a corner. His bowels were constipated but there was no difficulty in urination. There was a complete loss of sexual power. The pain was so severe that he was forced to take morphine, which he is now using in large doses. A thorough X-ray examination of his genito-urinary tract, including cystoscopy and catheterization of the ureters, was negative. A complete gastro-intestinal series showed some cæcal obstruction with adhesions around the appendix and cæcum, but was otherwise negative. The blood Wassermann was negative, but an examination of the spinal fluid in November, 1921, showed a 4 plus Wassermann with 10 to 11 lymphocytes to the field and a marked excess of globulin, on the basis of which an intraspinal and an intravenous salvarsan treatment were given.

The patient was admitted to the Lenox Hill Hospital on February 7, 1922, and on examination showed very little. He was haggard in appearance. His color was sallow, almost subicteric. There was some superficial sensitiveness in the right hypochondrium but no rigidity or mass. The most striking sign was a definite and marked rigidity of the dorso-lumbar spine. The pupils reacted to light and accommodation. The knee-jerks were lively. There was no sensory or motor disturbance. Heart, lungs and temperature were normal. An X-ray examination of the entire spinal column, heart and lungs showed a slight productive arthritis involving the anterior edges of the bodies of the upper dorsal vertebræ. There was a considerable enlargement of the thoracic aorta with distinct increase in density of the walls of the artery,

suggesting a specific aortitis and most of the anterior costal cartilages were ossified. Further spinal puncture was refused because of unpleasant effects previously experienced and was not urged, because of the patient's serious condition and because it was felt that little information could be gained therefrom.

After several consultations a provisional diagnosis of a lower thoracic posterior radiculitis, probably of luetic origin, was made, and an intense course of antiluetic treatment instituted. This was continued for about six weeks without improvement. Although there were slight remissions, the pain was still very severe, to alleviate which, larger doses of morphine were required. Lying down was practically impossible. He continued to lose weight rapidly, so that his total loss since the beginning of his illness was approximately sixty pounds.

On March 24 for the first time signs of a level lesion of the spinal cord were noted by Dr. O. Hensel in the form of a band of hyperæsthesia, about two inches in width, extending around the body about the level of the umbilicus. A further neurological examination at this time revealed that there was a left Babinski and a left ankle clonus and that all the deep reflexes of the lower extremity were exaggerated. The lower abdominal and cremasteric reflexes were absent. There was no marked disturbance in motor power, or of thermal, pain, tactile, muscle or articular sense, but a very definite loss of vibratory sense from the anterior superior spine down, especially left. In addition, the patient had difficulty in voiding and occasional catheterization was necessary. Unless under the influence of morphine he had an agonized expression and seemed in excruciating pain. Some œdema of the legs, especially at the ankles, had also developed. The patient actually looked cadaverous and gave the impression of being in a state of advanced cachexia. The diagnosis now was comparatively simple and the patient was examined repeatedly in order to more accurately localize the exact level of the lesion. With the assistance of Doctors Elsberg, Kennedy and Goodhart, the lesion was finally located at about the tenth to the twelfth thoracic segments involving both sides rather equally, but probably more on the right, and operation decided upon with the definite diagnosis of tumor of the spinal cord. The possibility of a malignant type of growth was seriously considered owing to the advanced cachexia of the patient.

April 11, 1922, under general anæsthesia, a curved incision was made with convexity to the left and including the seventh, eighth, ninth, tenth, eleventh and twelfth dorsal spines. The spinous processes and laminæ were exposed. The eighth to eleventh spines inclusive and the corresponding laminar arches were removed. Pulsation of the dura was apparently normal. On closer inspection, however, at the lower angle of the wound, a white spot was noticed over which the dura bulged slightly. The dura was opened at a point corresponding to this bulge and a definite extramedullary tumor was observed lying on the posterior aspect of the cord extending downward from a little above the eleventh arch. The growth lay a trifle to the right. It was found necessary now to remove the twelfth dorsal spine and laminæ and the dural incision was extended downward to below the lower limits of the growth, which ended approximately at the upper edge of the twelfth arch, the lesion being located several segments below the point anticipated. The tumor was a fair-sized ovoid growth about the size and shape of a small olive. (Fig. 1.) It was distinctly encapsulated and was easily shelled out without any damage to the cord and with only very slight oozing, which was readily controlled by hot saline wipes. A posterior root fibre on the left side ran through the growth and was divided. One bleeding point in the pia

was clamped and ligated. After hæmostasis was complete, the dura was sutured with a fine continuous silk suture.

The tumor was an irregular ovoid growth measuring 1⅛ inches in length, ⅝ inch in width and ½ inch in thickness. It had a distinct but thin capsule. The upper pole was somewhat larger than the lower and slightly lobulated. In color it was light reddish and in consistency it was rather soft. Microscopical examination (Doctor Bullock) showed the tumor to be a somewhat cellular neurofibroma or possibly a neurofibrosarcoma, probably quite benign in character.

The convalescence of the patient was entirely uneventful, the wound healing by primary union. Within twenty-four hours the patient voided spontaneously and the pains gradually subsided, although a slight subjective pain with a corresponding small area of hyperæsthesia in the right hypochondriac region persisted for some time. For a few days he complained of a subjective feeling of numbness in the lower extremities, although no marked sensory or motor disturbance could be elicited. Eight days after operation the left cremasteric reflex reappeared and about the same time morphine was discontinued. Patient was out of bed twelve days after operation and one week later began to walk without much difficulty. At this time it was noted that the left Babinski had disappeared, that the knee-jerks were less active, that both cremasteric reflexes had reappeared and that the area of hyperæsthesia in the right hypochondrium had also vanished. The slight subjective pain in the right hypochondriac region which had persisted had become very insignificant. The entire expression of the patient had changed and he seemed to be gaining in weight. He was discharged from the hospital May 13, having gained about eight pounds in weight since the operation. For a time his gait was slightly ataxic, but this symptom quickly disappeared. He continued to gain weight very rapidly. His sexual power returned in September, 1922, when he approached his normal weight. He has been perfectly well as regards his spinal cord condition since, in spite of an attack of pulmonary tuberculosis in 1924–1925, from which he recovered at Saranac Lake, where he spent nine months. His present weight is 198 pounds, which is at least ten pounds in excess of his best weight before his illness.

FIG. 1.—Intradural extramedullary neurofibroma of the spinal cord, simulating abdominal malignancy.

DOCTOR STETTEN said that the reason of his presenting this case of intradural extramedullary neurofibroma of the spinal cord was not because he wished to emphasize particularly the successful result of operative treatment,

but to call attention to the difficulties of diagnosis and to illustrate how a case of this type may readily simulate an intra-abdominal malignant lesion. Even with all the data of numerous previous examinations available and a suspicion that a spinal cord lesion was at the basis of the patient's trouble, it was only possible to arrive at a definite diagnosis after nearly two months of the most careful observation.

COMBINED SECONDARY THYROIDECTOMY AND THYMECTOMY FOR INTRACTABLE EXOPHTHALMIC GOITRE

Dr. De Witt Stetten presented a woman, age twenty-eight years, who was admitted to the Lenox Hill Hospital, October 28, 1915. She was at that time eighteen years of age and gave a history of having noticed a thyroid swelling for four years, with tremor, increasing nervousness, slight exophthalmos, palpitation, hyperidrosis and loss of weight for two and a half years. The disease progressed in spite of medical treatment and July 24, 1914, the entire right lobe of the thyroid was resected by Dr. E. W. Peterson without much improvement in the patient's condition. On April 20, 1915, an adenoma in the lower portion of the left lobe was removed by Dr. S. Lloyd, but there still was no improvement, and the remaining part of the left lobe continued to grow. A seven-year older sister was also a sufferer from exophthalmic goitre. Examination of the patient showed the symptoms and physical signs of an advanced case of exophthalmic goitre. She weighed 119 pounds. She flushed easily and perspired profusely. She was so extremely nervous and restless that she was on the verge of a psychosis. She displayed choreiform movements of such a pronounced degree that at times it was difficult to keep her in bed. Her heart was enlarged and there was a moderate tachycardia, 120–130. There was a slight exophthalmos but the usual eye symptoms were not in evidence. There was the typical scar of a collar incision and a decided enlargement of the remaining portion of the left lobe of the thyroid. There was no presternal dulness. X-ray examination showed only an enlargement of the heart with no substernal thyroid or enlarged thymus. Blood count showed a leucopenia with marked lymphocytosis, white blood-cells 5300 with 50 per cent. lymphocytes. Her blood-pressure was low, 114/68. There was no alimentary glycosuria. The adrenalin test was negative. The Loewi reaction was not present. There was a pronounced Aschner phenomenon, pulse before eyeball pressure 110, after 100. On injection of pilocarpin gr. 1/10, there was a profound, almost an alarming reaction, with such profuse salivation and sweating, that the patient nearly collapsed. The marked pilocarpin reaction, the decided Aschner phenomenon, the increased carbohydrate tolerance, even after adrenalin injection, the profuse hyperidrosis with clammy extremities, low blood-pressure, slight exophthalmos and moderate tachycardia with definite subjective symptoms, all suggested a case of exophthalmic goitre, in which the vagotonic symptoms were at least pronounced—a case in which if there was any foundation to the theory it might be presumed that the thymus had a preponderating influence.

The patient's condition, in spite of three weeks in bed and careful medical treatment, became worse, and although the case was not looked upon as the best operative risk, it was decided to remove part of the remaining thyroid tissue and at the same time attempt a thymectomy as advised in this type of case by Haberer, Klose, Garré, Halsted and others. After postponing operation on several occasions because of the patient's critical condition—once even sending the patient back from the anæsthetizing room—the operation

was finally performed November 18, 1915. General anæsthesia was used because of the extreme restlessness of the patient. The remains of the left lobe of the thyroid were exposed through the old transverse collar scar and a small portion of the lower part was resected. Exposure was difficult owing to adhesions and cicatricial tissue and there was considerable oozing. A second incision was then made downwards, perpendicular from the transverse incision to below the suprasternal notch. The upper anterior mediastinum was exposed and the fat and glandular tissue lying between the sternum and trachea were removed. The total mass was not large, about the size of a pigeon's egg. It seemed to be mostly fatty tissue but rather more fibrous and more yellow than normal fat. The patient left the table in some shock with a pulse of 168. She promptly recovered from the post-operative shock and although a stormy course was anticipated, her convalescence was most uneventful. There was no real acute hyperthyroidism whatsoever. There was only a very slight rise of temperature for the first two days. Within forty-eight hours the pulse rate came down to 100, where it remained. The reaction was much less than is usually shown by the average case of exophthalmic goitre after the ligation of a single artery under local anæsthesia. This is quite in line with the well-known experience of Haberer, after the removal of even a very small fragment of thymus. The microscopical examination of the tissue removed from the anterior mediastinum showed it to be atrophic thymus tissue imbedded in fat. The patient steadily improved after the operation. Her choreiform movements gradually left her and within two months she had gained 15 pounds in weight. The pilocarpin test was repeated and gr. 1/10 had as little an effect upon her as a dose of distilled water, while on the other hand the adrenalin test became positive. For a time her heart action was variable and her blood picture did not change. Her tremor improved but did not entirely disappear. She began work about two months after her operation and has continued at office work since. She was presented at the January 7, 1916, meeting of the Surgical Section of the New York Academy of Medicine, practically well. In the Fall, 1918, epidemic she survived a severe influenza pneumonia and in the Spring of 1925, she was thoroughly examined by Dr. O. Hensel, who pronounced her a one hundred per cent. functional cure.

At a recent examination her pulse was 84, and aside from a slight nervousness without tremor there was no evidence that the patient had ever suffered from hyperthyroidism. In the Spring of 1925, she weighed 132 pounds, but has lost about ten pounds since that time. This she attributes to trouble with her teeth, several extractions and worry over family troubles. Her blood picture is practically normal: white blood-cells, 7200; polymorphonuclears, 57 per cent.; small lymphocytes, 35 per cent.; large lymphocytes, 7 per cent.; eosinophiles, 1 per cent.

Doctor Stetten also presented the sister of this woman; she is seven years older than her sister. Since the age of thirteen she has been a sufferer from exophthalmic goitre. She was operated on by Dr. J. M. T. Finney, in Baltimore, on July 17, 1915, when a subtotal thyroidectomy was done, the right lobe and all but the upper portion of the left lobe being removed. She made a good recovery and was well for nine years, gaining thirty-five pounds in weight. About one year ago her illness recurred with a corresponding hypertrophy of the remnant of the left lobe. She had symptoms very similar to her sister's, except that they were of a much milder nature and that there was a much more pronounced exophthalmos with characteristic eye symptoms. Her pulse rate was only 104. She was admitted to the Lenox Hill Hospital on September 16, 1925, and very carefully studied. The usual tests were

applied and a diagnosis of exophthalmic goitre of the vagotonic type with moderate thyrotoxicosis, was finally arrived at. It was planned to carry out a procedure similar to what had been done in the sister's case and the operation was performed on October 5, 1925, under general anæsthesia. By means of an incision through the old collar scar the hypertrophied remaining portion of the left lobe of the thyroid was exposed. The upper pole was ligated and a wedge-shaped resection of the left lobe was done, leaving only a small portion attached to the trachea. The retrosternal space was now explored for a thymic rest, but nothing could be found, not even fat tissue. There was only a rather mild post-operative hyperthyroid reaction. The patient's further convalescence was quite uneventful.

The first case was presented simply on its face value without any attempt to hold a brief for thymectomy. It may be that the secondary thyroidectomy was just enough to produce the satisfactory result. The main argument in favor of the value of thymectomy is the exceptionally uneventful convalescence, in spite of the extreme gravity of the patient's illness and the severity of the operation, which is an observation that has been made by others. The fact that pilocarpin, which produced such a marked effect before the operation, should become absolutely innocuous thereafter, strengthens the view that the patient's recovery was influenced by the removal of the thymic remnant.

Dr. Alexis V. Moschcowitz said that he has paid particular attention to the cases of exophthalmic goitre which were accompanied by an enlargement of the thymus gland and he has found that as a general rule these enlarged thymus glands cause neither symptoms prior to the operation, nor any post-operative complications. However, Doctor Moschcowitz has lost two cases of exophthalmic goitre during the past year, and in both instances there was present a greatly enlarged thymus gland, sufficient to cause compression of the trachea.

He was interested in the statement of Doctor Stetten that the lobectomy in his case did not produce any amelioration of the symptoms. This experience of Doctor Stetten's is quite contrary to the speaker's experience, as he has found that there is usually a very prompt amelioration of the symptoms following lobectomy; this improvement, however, hardly ever lasts more than six months, whereupon there is a prompt return of practically all of the symptoms.

In the operative treatment of goitre, lobectomy takes about the middle place with an improvement of about six months while the improvement after ligation is so evanescent that it lasts only a few days. On the other hand, the improvement after sub-total thyroidectomy is not only prompt, but lasts also a very long time; how long cannot be stated, as the operation of sub-total thyroidectomy is of comparatively recent date.

RETROPERITONEAL SARCOMA (ADRENAL TUMOR?) WITH HEMORRHAGE. THREE YEARS AFTER OPERATION

Dr. Harold Neuhof presented a woman, now thirty years old, who came under observation in December, 1922, with the history that an appendectomy had been done two years before for recurring abdominal cramps of several months' duration. After operation, she had felt well for a few

months. She then began to experience epigastric fulness after meals, no matter how little she ate. There were no other symptoms. Six months before admission to the hospital she began to note loss of weight which she believed amounted to fifteen pounds at the time of her admission to the hospital. Twenty-four hours prior to admission, violent cramp-like pain in the right lower quadrant began, continuing with increasing intensity. She vomited three times. Bowels moved with enemata. There were frequent chilly sensations and one well-defined chill shortly before admission. When the patient was seen by him one hour before entry into the hospital, a large cystic mass occupying the mesial and right side of the upper abdomen was noted. By the time the patient had entered the hospital, this mass had increased considerably in size.

On admission, the patient was found profoundly prostrated, pale, the respirations somewhat accelerated, and with wan and pinched facies. The general physical examination was negative except for a few moist râles at the right apex. On inspection of the abdomen, a large, rounded, protruding mass was seen, occupying the mid-portion and right side of the abdomen. The overlying skin was tensely stretched and the umbilicus pushed to the left and upwards. The mass was globular, about 20 cm., in its vertical and transverse diameters, smooth, tense, with a sense of fluctuation, tender, and fixed. The overlying abdominal musculature was rigid, but there was no generalized rigidity. On percussion, flatness existed only over the most prominent part of the mass. The white blood count was 21,200, with a differential of 80 per cent. polymorphonuclear leucocytes.

Shortly after admission to the hospital, a free right upper rectus incision was made over the bulging portion of the mass. Upon opening the abdomen an enormous bluish tumor mass at once presented. The transverse colon was found to be displaced downwards and the mass appeared to lie in the transverse mesocolon. Over its upper surface, several greatly distended veins were noted. When the hand was passed into the abdominal cavity, the mass was felt to extend to the left as far as the spleen and to the right to the region of the right kidney, but the hand could not be passed around the mass. The deep limits were likewise ill-defined. Because of the firm consistency of the mass, enucleation of the clot and packing did not appear to be a procedure that would be safe or most likely to control the hemorrhage. Accordingly, an attempt at removal was decided upon. The overlying transverse mesocolon was incised and bluntly separated. Additional thin layers of connective tissue overlying the mass were separated, until a plane of cleavage was found. It was then clear that some type of capsule held the blood mass together. The overlying dilated veins were tied off and blunt dissection continued to the left in order to identify the colica media vessels. One branch had to be clamped and these vessels could then be retracted to the left. Further blunt dissection toward the left side of the mass established its retroperitoneal situation in juxtaposition to, but not derived from, the pancreas. Carrying the blunt dissection between pancreas and the mass, the latter could be partly lifted out of the abdomen for the first time. Making gentle traction on it, the right kidney was found to be drawn forwards. Sharp and blunt dissection was then continued over the right lateral aspect of the encapsulated blood mass. The third portion of the duodenum, closely related to the capsule, was dissected free and the pedicle could then be clearly identified. This was a flat mass of tumor tissue attached to the capsule of the upper pole of the right kidney but apparently not involving the kidney itself. The kidney appeared normal in size and consistency. It became now evident that the tumor might not be completely removed without sacrifice of the upper pole

of the kidney. Accordingly, mattress sutures of chromic gut were passed through the upper portion of the kidney and tied, the kidney severed beyond these sutures, and the upper pole of kidney, together with the enormous blood clot mass, was removed in one piece. A packing of gauze was introduced into the retroperitoneal space, surrounded by a strip of rubber dam; the remainder of the posterior peritoneum was sutured and the abdominal wound closed in layers around the drain.

The specimen was a spherical mass from 15 to 20 cm. in each diameter with a thin, confining membrane that held the blood clot together. Upon section, it consisted of recent and old blood clot and considerable fluid blood. Scattered throughout the blood clot were tumor masses of varying size, of grayish color, fragments of tumor tissue being freely distributed toward the periphery. The pedicle was a grayish tumor mass of uniform consistency. The attached portion of the kidney appeared normal. This was confirmed by the microscopic examination. The tumor tissue was reported angiosarcoma.

The patient suffered considerable shock after operation, from which she recovered in three days. Pronounced abdominal distention was controlled by colon irrigations. The abdominal wound healed promptly after the removal of the drains. Two weeks after operation, when the patient appeared convalescent, there was a sudden onset of pain in the right chest and shoulder and physical examination revealed the existence of a pneumothorax. This was confirmed by X-ray. Two weeks later, pneumothorax had cleared up, its cause not having been determined, and the patient was discharged symptom-free.

Up to the present time, there have been no evidences of recurrences of the neoplasm. Deep X-ray therapy was employed over a period of several months. Two years after operation, the patient was admitted to the hospital for study to determine if possible whether or not recurrence or metastasis existed. X-ray examination of the chest and bones was negative. A gastro-intestinal X-ray examination was negative. No evidence of a lesion in the urinary tract was found by cystoscopy. Abdominal examination was and remains negative for the presence of a mass suggesting recurrence. The patient is in perfect health and has gained about twenty pounds since operation.

Although some adrenal tumors present the microscopic characteristics of the organ from which they are derived, there are others that can only be identified by their situation and characteristics. In this case a careful search was made in the effort to definitely place the neoplasm in the adrenal category. No trace of adrenal characteristics having been found, the conclusion that the tumor was probably derived from the adrenal can only be based on the clinical picture. The latter, as given in this case report, is typical of an adrenal tumor with hemorrhage.

INTRADURAL, EXTRAMEDULLARY SPINAL CORD TUMOR

Dr. Harold Neuhof presented a woman, sixty years old, who had been in good health until the summer of 1924. She then began to complain of dyspnœa on exertion. In August, pain in the left precordial region began, which was present at frequent intervals. This, too, was more marked upon exertion and frequently radiated backwards to the scapula and occasionally down the left arm. In September, epigastric distress and some difficulty in swallowing began, the latter being described as a delay of food before it entered the stomach. As a result of these manifestations, medical attention was first directed to the cardio-vascular system and, later, to the œsophagus and

stomach. Œsophageal bougies were passed without meeting obstruction and then treatment was directed towards the gastric symptoms. The gastro-intestinal examination by X-ray was negative. Until December, the patient was under treatment for the precordial pains and the symptoms referable to the œsophagus and stomach. About December, 1924, five months before admission to the hospital, cramp-like pains in the calves began. These pains were usually present on arising in the morning, to disappear after the patient had walked about for a time. Occasionally, these pains would occur during the night. In February of this year, that is two months before admission to the hospital, the first clean-cut symptoms referable to a spinal cord lesion began. There was first noted difficulty in walking due to weakness of the lower extremities, weakness being more marked in the left. This was progressive, so that, at the time of admission, the patient was unable to walk. There was at no time numbness or tingling or other sensory disturbances referable to a spinal cord lesion. A few weeks before admission difficulty in urination began, consisting in straining efforts to empty the bladder. This has been progressive but there has been no retention of urine.

Physical examination was in striking contrast to the paucity of the sensory neurological manifestations. The clinical picture was a classical one for a spinal cord tumor in the upper dorsal region. There was profound weakness of the lower extremities, more marked on the left side; the abdominal reflexes were absent; knee-jerks and ankle-jerks were hyperactive and there was a bilateral Babinski phenomenon. On the right side of the body from the level of the fifth dorsal segment downwards, there was considerable impairment of the pain and temperature sense, moderate diminution in tactile sense. The only sensory disturbance on the left side was a belt of hyperæsthesia at the third dorsal segment. The lumbar puncture demonstrated the existence of a partial spinal block.

May 1, 1925, a typical laminectomy was carried out, first on the second and third dorsal vertebræ and then on the first dorsal. The tumor was found at a somewhat higher level than had been anticipated. Upon opening the dura, the spinal cord was found pushed to the right and rotated by a neoplasm lying on its left side, opposite the first and second dorsal vertebræ. It was for the most part of firm consistency, about 2 cm. long. The tumor was firmly impinged against the left ventro-lateral aspect of the cord. The only unusual feature noted at operation was the wide attachment of the neoplasm to the inner surface of the dura. After dividing one posterior spinal root that was adherent, the tumor was lifted away from the surface of the cord. The second left anterior root was seen to be attached to the neoplasm and was also sacrificed. In order to remove the neoplasm completely, the dura was freely sacrificed beyond the site from which the tumor sprang. Another reason for this free removal of dura was to obviate recurrence, it being my impression that so-called recurrences of dural endotheliomatas may be incomplete removal of the tumor, a fragment being left attached to the dura in the effort to save the dural sac. The dural sac was partly sutured and the remainder of the wound closed in layers. Pathological report was endothelioma.

One unusual phenomenon developed on the third day after operation, consisting in left-sided enophthalmos and narrowing of the palpebral aperture and dryness of skin on the left side of the body from the third dorsal segment downwards. This was apparently referable to some injury of the cord at operation, but cleared up in a few days. The post-operative convalescence was smooth and the patient was discharged from the hospital walking and with fair power in the lower extremities.

It is now six months since operation. There is normal power in both lower extremities, no sensory disturbances and only a left Babinski phenomenon remains as evidence of the previous spinal cord lesion. The precordial distress, as well as the œsophageal and the gastric manifestations, have disappeared.

PERFORATED GASTRO-JEJUNAL ULCER, SIX AND ONE-HALF YEARS AFTER GASTRO-JEJUNOSTOMY

DR. HAROLD NEUHOF presented a man, now sixty-seven years old, who was first admitted to the first surgical service at Bellevue Hospital in June, 1916. At that time he presented the picture of an acute abdominal condition for which immediate operation was required. At operation, an abscess in the region of the duodenum was drained. A duodenal fistula developed and a gastro-jejunostomy was done three weeks later. The fistula gradually healed after several months' treatment. A few months later, the patient was under hospital observation for a short time because of some symptoms suggestive of recurrence of an ulcer. X-ray and other forms of examination were negative, however, and the patient then disappeared from observation. From December, 1916, to December, 1922, that is six years, the patient was absolutely free from any symptoms referable to the gastro-intestinal tract. There were no dietary restrictions, alcohol was used in moderation. He was readmitted to the hospital on December 16, 1922, with the following history: About ten days before admission epigastric distress began and, with intervals, was persistent. Three days before admission, the distress was pronounced, the abdomen became distended. Twenty-four hours before admission, severe abdominal pain began, first in the epigastrium and then generalized, and the patient vomited four times. Bowels had not moved for five days.

The man was profoundly prostrated. The pulse was small and rapid, the temperature 102°. The abdomen was greatly distended, especially in its upper half, where slight traces of visible peristalsis were to be noted. There was generalized abdominal tenderness, especially marked on the left side. Generalized abdominal rigidity existed. A high colonic irrigation was ineffectual. White blood count was 22,400 with 92 per cent. polymorphonuclear leucocytes.

Shortly after admission to the hospital, the abdomen was opened through a left rectus incision and there at once escaped a considerable quantity of yellowish, odorless fluid in which fat globules floated. Masses of fibrin were seen on the injected serosa of loops of small intestine that were encountered. The character of the peritoneal fluid changed as the exposure was continued upwards. Thin pus was encountered, changing to frank thick pus towards the root of the transverse mesocolon. After the pus was removed by suction, a perforation at the gastro-jejunal anastomosis was exposed. This perforation was in the jejunum on the left side of the anastomosis. It measured about 2 by 1 cm. and was wide open. The remainder of the anastomosis was represented by a firm infiltrated ring, evidently an extensive ulcer. The short segment of jejunum proximal to the anastomosis was collapsed; that distal to the stoma dilated. Because of the patient's condition, the limits of the gastro-jejunal ulcer were not determined. The operation was begun under local anæsthesia and concluded with gas oxygen. After the nature of the lesion had been determined, the site of perforation was packed off, the transverse colon elevated and two layers of sutures of chromic gut employed to close the perforation. These sutures did not hold well in the

infiltrated tissue and the peritoneum of the adjacent mesocolon was therefore used as an additional flap over the suture line. The wound was closed with drainage.

After a stormy immediate post-operative period, convalescence was smooth and the patient was finally discharged symptom free.

It is now three years since operation and the patient has remained entirely free from symptoms during this period. He has not placed himself under any dietary restrictions. A gastro-intestinal X-ray examination shows a normally functioning gastro-jejunal stoma without any evidence to suggest that the ulcer at the anastomosis has persisted.

BRONCHOSTOMY FOR BRONCHIECTATIC SUPPURATION IN UPPER LEFT LOBE OF LUNG

DR. HAROLD NEUHOF presented a woman, sixty-three years old, who came under observation a year and a half ago with the following history: The existence of diabetes was known for about a year. Four months before the time she was first seen by the reporter, a number of teeth were extracted under local anæsthesia. The next day she coughed up small quantities of black material. Thereafter she felt well for three weeks, when coughing of purulent sputum began. This continued for several days. Then, quite suddenly, the patient coughed up a large quantity of foul pus. Fever set in at this time and continued to range between 100° and 104°, often accompanied by profuse sweats. There were several hæmoptyses. Progressive loss in weight was noted and at the time of admission to the hospital, the patient was about fifty pounds underweight. From the time that purulent expectoration began, the sputum was continuously foul smelling, varying in quantity from 5 to 20 ounces daily. On admission to the hospital, four months after the onset of the illness, the patient was found to be in fair general condition but markedly emaciated. The diabetes was of moderate severity. The examination of the chest showed all the physical signs of extensive infiltration and cavitation in the left upper lobe. This was substantiated by the X-ray examination. Bronchoscopy was not satisfactory because of the patient's condition. It appeared to show pus escaping from all the bronchi on the left side. In the diagnosis, a malignancy of the lung had been considered because of the patient's age and general appearance. The history of extraction of teeth did not appear to establish a definite etiology for the pulmonary condition, but it was nevertheless considered the probable cause. With an ante-operative diagnosis of bronchiectatic suppuration in the left upper lobe, operation was performed November 18, 1924.

Under local anæsthesia, a segment of the anterior portion of the second rib was removed. There were pleural adhesions over a small area and through these approach to the lung was carried out. Aspiration revealed a small amount of foul material. The lung was incised along the tract of the aspirating needle and was found to be densely infiltrated. This was evidently not the main focus and the infiltrated lung was therefore incised more deeply. At a depth of about 4 cm. from the surface of the lung, a large cavity containing a pool of putrid material was encountered. This was freely laid open by incision through the infiltrated lung, and evacuated by suction. The cavity was then found to have a smooth lining and on its floor presented several large bronchial orifices. Rubber dam and gauze drains were inserted.

Within a few days of operation, the purulent sputum had ceased and from that time to the present, there has been no cough or expectoration. The progress of the wound was satisfactory. A soft rubber tube was inserted into

the cavity four days after operation and the bronchial fistula maintained in this manner. Although the wound showed a tendency to close, the bronchial fistula was kept up by keeping a small tube *in situ* for three months after operation. At that time the general condition of the patient was excellent. She had regained the weight that had been lost, the examination of the chest and the X-ray examination showed no evidence of infiltration in the lung, and the fistula was therefore permitted to close. It is now eleven months since operation and the patient has remained well.

Dr. Howard Lilienthal called attention to the possibilities of the operation of bronchostomy, the opening of the bronchus for the purpose of aëration of parts of the bronchial tree when filled with pus and which air cannot otherwise reach. Doctors Neuhof and Willy Meyer had done good work in establishing a bronchial fistula in such cases and this operation has its uses if one cannot do anything else to effect a cure. In the first case on which the speaker had seen Doctor Neuhof operate, the patient had bilateral disease and he had believed nothing much could be done for him; but after the bronchostomy he improved, lost the fever, gained weight and there was no further discharge. His other lung got pretty nearly well also. Doctor Lilienthal said he had seen good results follow in another case, in this instance not from a bronchostomy, but from an accidental opening of a bronchus which drained a lung abscess, and the opening was maintained long enough for aëration of the bronchial tree to accomplish good results. However, the operation is far from being devoid of danger. The patient may die of air embolism. The speaker had seen that occur in several cases. The danger of hemorrhage is great. But there are cases in which nothing else can be done. The patient presented was a beautiful example of the drainage and healing of a progressive lung abscess which would have killed her if she had not been operated upon.

Dr. Nathan W. Green agreed with Doctor Lilienthal that it was a rarity to get an accidental bronchostomy after a drainage case of abscess, although it could not really be called a bronchostomy. The speaker had had a number of these cases and had not yet seen one permanent fistula after a drainage operation. He had seen some of the cases reported by Dr. Willy Meyer in which this condition has served very well to give aëration and the patients have gone along very well, the only disadvantage being that they must be careful when bathing for fear of drowning.

Doctor Neuhof, in closing the discussion, said that in the great majority of cases that had come under his care the suppuration was bronchiectatic, and therefore at operation the search was made for the main focus characterized by dilated bronchi. One often finds a smoothly lined cavity containing foul material, whose floor presents several open mouths of dilated bronchi. To establish a long lasting fistula communicating with such bronchi is as much the operation of bronchostomy as in the less common cases in which considerable infiltrated lung must be traversed to find a dilated bronchus that is not part of a bronchiectatic cavity. The principle of the operation is not drainage in either case, for drainage would be discontinued when the

discharge had ceased. If the latter were done there would be prompt recurrence of the manifestations of the disease. The principle is the ventilation or aëration, by way of the bronchial fistula, of an anaërobic bronchiectatic suppuration. A drainage operation may have its field in the parenchymatous abscesses that are not anaërobic or bronchiectatic. Since 1919, when he first practiced the operation of bronchostomy on Doctor Lilienthal's service at Mount Sinai Hospital, the speaker has performed the operation in forty-three cases. Of these, four have died; two of cerebral embolism, one from anaërobic suppuration in another lobe of the lung, and one from the continuation of a virulent infection uninfluenced by operation. Of these cases three can be classified as acute gangrene, in which the prognosis is always grave. Of the remaining thirty-nine cases the great majority are well, the others improved. There is one case not doing well, in which there was probably an error in diagnosis, the lesion being suspicious of tuberculosis. In view of these results the question is what alternative procedures should be advocated in the operative treatment of anaërobic pulmonary suppuration.

FRACTURE OF SHAFT OF FEMUR; DELAYED REDUCTION BY SKELETAL TRACTION

Dr. John A McCreery presented a man, aged forty-two years, who was admitted to the First Surgical Division of Bellevue Hospital, September 9, 1921. Shortly before admission he had fallen about twenty feet into the hold of a ship, the broken beam on which he had been sitting falling on top of him. The injuries sustained consisted of a compound fracture of the lower jaw, a fracture of the right humerus in its middle third, and of the right femur at the junction of the lower and middle third. He was immediately put in suspension and traction apparatus, with skin traction, the weight of ten pounds being applied to the femur. For some time following the injury the patient was extremely ill, developing broncho-pneumonia, and was restless and hard to control.

An X-ray taken twelve days after injury showed overriding of about one inch. Eight days later this had increased to nearly two inches with posterior displacement of the lower fragment. Skin traction was obviously inadequate, in part due to the man's unusually good musculature. Three weeks later there was apparently union with two inches of shortening, and a firm mass, presumably callus, could be felt around the bone ends. Open operation seemed contra-indicated as the man seemed only just recovering from pneumonia and still had an infected mouth, as a result of the compound fracture of the lower jaw.

It was decided to try caliper traction, although it was not believed that this would be efficient. Accordingly calipers were applied with a weight of twenty-five pounds for forty-eight hours. This was then increased to sixty pounds without complaints on the part of the patient, who said, however, that twenty-four hours after the increased weight had been applied he felt something slip in his thigh. This was confirmed by X-ray, which showed a definite diminution in the shortening and beginning formation of callus. This traction was continued for ten days, when it was reduced to thirty pounds, and ten days later to twenty pounds. X-ray taken three weeks after beginning caliper traction showed the overriding completely overcome but with persistent but decreased posterior displacement of the lower fragment.

The calipers were removed from the femur one month after application, and at that time the measurements from the anterior superior spine to the internal malleolus were equal on the two sides. The patient was discharged from the hospital on crutches four months after admission. At that time he had forty degrees of motion in the knee-joint from a straight angle. When seen ten months later, this had increased to eighty degrees. At the present time he is working as a longshoreman without disability.

This case is of interest in demonstrating the possibilities of skeletal traction in cases where a certain amount of union has already developed.

TRAUMATIC RUPTURE OF SMALL INTESTINE IN AN HERNIAL SAC

Dr. John A. McCreery presented a man, who was admitted to the First Surgical Division of Bellevue Hospital, November 21, 1921. A few hours before admission he had been cranking an automobile which started forward, wedging him between it and a box car, the bumper of the truck catching him in the right groin. Following the accident he had had constant severe pain around the umbilicus, occasionally radiating to the right groin. He did not vomit nor did he feel nauseated. His previous history was irrelevant, except that for ten years he had had a reducible right scrotal hernia.

On admission the man was in slight shock complaining of severe generalized abdominal pain. There was generalized abdominal rigidity and tenderness both more marked in the lower abdomen. There was a tense, non-tender reducible right inguinal hernia. At operation performed eight hours after injury, it was found that the small intestine about 6 inches from the ileocæcal valve had been cut through transversely, the laceration extending about 1½ inches into the mesentery. It was a clean cut as though done with a knife. Both ends of the intestine were open and the upper end was discharging fecal contents into the pelvis. The peritoneum was congested and lustreless and there was already a considerable amount of fibrin in the pelvis and on the surface of the small intestine. Because peritonitis had already developed, no attempt was made to repair the divided intestine, both ends of which were brought out through the lower end of the exploratory incision. The pelvis was emptied by suction and a cigarette drain inserted.

His post-operative course during the first week was marked by moderate distention which was controlled by lavage and irrigation through the protruding loop of small intestine.

Eight days after the first operation an end-to-end repair was made with two layers of chromic catgut, the inner mucous membrane suture, the outer seromuscular, and the protruding intestine was then reduced into the abdominal cavity, after gently separating adhesions. The abdominal wound was closed loosely.

Following this the patient was made uncomfortable by a post-operative parotitis which was found to be due to staphylococcus albus, and which subsided after ten days of repeated massage. The repair of the fistula was not permanent, a small amount of fecal discharge appearing five days after operation and continuing in diminishing amounts for five weeks.

At the time of discharge from the hospital, two months after injury, the wound was entirely healed. His inguinal hernia at this time seemed cured, as there was no impulse or bulge noted, and a hard non-tender mass could be felt in the canal, extending a short distance below the external ring, presumably organized exudate in the hernial sac.

He was seen at intervals in the follow-up clinic, and it was noted that

there was developing a ventral hernia at the site of his exploratory incision. This has been controlled by a belt. A definite recurrence of the right inguinal hernia was noted first two and a half years after his injury. In view of patient's age and his occupation, which involved no manual labor, this has been kept under control by a truss rather than operative repair.

The character of the injury in this case was such as to suggest that the intestine had been divided in the hernial canal by the impact of the bumper cutting it on the ramus of pubis, and he is shown as a case of intestinal rupture from a rather unusual cause. The temporary cure of his hernia, presumably by organization of exudate in the inguinal sac, is also of interest.

TRAUMATIC RUPTURE OF SMALL INTESTINE DUE TO EXTERNAL VIOLENCE

DR. CARL EGGERS said that in 1922, he had a case similar to Doctor McCreery's. December 11 of that year he was called to see a lady, seventy-two years of age, on whom he had done a nephrectomy for right pyonephrosis, by the transperitoneal route, a year previously. At six o'clock of that same evening, feeling perfectly well, she suddenly stumbled while stepping from the sidewalk onto the street, and collapsed, striking her chin. She was picked up by a taxi driver and taken home. She immediately complained of agonizing pain in the right side of her abdomen and was in a state of shock. She stated that she felt as if something had given way inside. A physician who saw her soon after the accident believed the condition had some relation to the abdominal scar. He administered morphine and, when the pain did not subside, gave her a second hypodermic about two hours later.

When Doctor Eggers saw the patient, at 9.30 that evening, she was in a state of shock, was very pale, pulse 74 and temperature 100. She complained of severe pain over the entire right side of the abdomen and, in addition to that, of a terrible pressure as if from a heavy weight. Three times during the abdominal examination she vomited clear stomach contents. She was unable to void, although she had a desire to do so; she had voided last before 5.00 P.M., about one hour before the accident. She had worn a double truss for bilateral inguinal hernia while out walking. The abdomen was slightly distended and there was marked tenderness and some rigidity over the entire right side. There was no irregularity in the scar of the former operation which might suggest a hernia. Further examination showed that the left inguinal hernia was easily reducible and not at all tender; the right one, which was much smaller, was irreducible and extremely tender, so that she could not bear having it touched. A tentative diagnosis of strangulated hernia was made, although it hardly explained all the symptoms and signs.

Operation was performed at the Lenox Hill Hospital six hours after the accident. Local (one-half per cent. novocaine) anæsthesia was used. While injecting the solution the tension in the hernial sac suddenly seemed to disappear, although just before the injection it had been larger and more tense than early in the evening. Proceeding with the operation the sac was found to be thick-walled; as soon as it was opened turbid fluid exuded which was cultured, later being reported negative. A great deal of this fluid was mopped out. It looked like contents of small intestines, there was no fecal odor. The sac was split completely, for thorough examination, and a loop of small intestine was then picked up which looked red and injected and showed fibrin deposits. There was no free gas in the abdomen. It was impossible to bring the cæcum and appendix into view. Upon picking up another loop of small gut for exploration, a ragged hole, about one-half inch long, was

discovered opposite the mesentery. Its edges did not look fresh; they were covered with a grayish deposit and there was no bleeding. The long axis of the tear corresponded with the long axis of the gut. There was no induration of the wall. The tear was closed with one row of silk sutures, and the loop dropped back. The remaining fluid was sponged out, and closure of the sac and a hernial repair completed the operation. The wound was not drained.

The rupture of the small intestine in the hernia sac was due in all probability to pinching of the truss. The lining of the sac was red and velvety; histological examination showed acute suppurative inflammation with destruction of the endothelial lining.

The immediate post-operative condition was very good; there was almost complete relief of pain and vomiting ceased entirely. Towards the end of the second day moderate abdominal distention developed, with tenderness and rigidity over the lower quadrants. This continued, although she passed gas freely. She also developed gradually increasing temperature which could not be explained except on the basis of a mild peritonitis, until she developed parotitis on the left side, a small patch of pneumonia in the left lower lobe and a mild superficial infection in the wound. In addition to all this, she began to vomit about ten days after the operation and complained of abdominal pain. No explanation could be found for this until it was noticed that the left hernia, which had hitherto been easily reducible, could no longer be pushed back. It was hard and tense and very tender, although the patient had not complained of pain in that region. As soon as her condition warranted, fifteen days after the accident, the left side was opened, also under local anæsthesia, and a large sac was exposed which exuded clear fluid when opened. A mass of omentum was firmly adherent within it and there was redness and a thick deposit of fibrin. The omentum was separated and reduced, the sac removed, and a Bassini hernioplasty was done.

The convalescence after this was uneventful, the wound healing by primary union.

The explanation of the incarceration of the left side is probably the following: The extravasated intestinal contents set up a mild peritonitis, especially in the hernia sac, in which it stagnated and, when the omentum drifted into it, adhesions formed and prevented reduction.

The interesting points in this case are the severity of the lesion in relation to the comparatively slight trauma, which consisted only in pinching of the gut by a truss, with no external evidence of injury, and the severe degree of peritonitis set up in the course of six hours.

The question of drainage in these cases is also of considerable interest. Doctor McCreery's case was drained; my case was not drained and was followed by primary union except for a slight subcutaneous infection. It is surprising how nature takes care of these aseptic exudates from the small intestines. For example, two cases of rupture of the small gut due to external violence, with no visible marks on the abdomen, were observed by me during the late war. Both patients were soldiers and were struck on the abdomen by a mule. The first case was said to have been thrown about sixteen feet, and the other almost as far. One patient was operated on by Major Wm. Crawford of Savannah, Ga., at the Base Hospital, Camp Jackson, S. C. He found a partial tear of the small intestines. After repairing the laceration

and sponging out the exudate, the wound was closed without drainage, and primary union resulted, except for a slight superficial infection. The second case had an extensive hemorrhagic exudate due to laceration of vessels in the transverse mesocolon, and a complete severance of the small intestine about the junction of the jejunum and ileum, extending into the mesentery. The vessels in the transverse mesocolon were ligated by Doctor Eggers and the tear repaired. The gut was then united by end-to-end anastomosis and the exudate removed by sponging. No drainage was instituted and the wound healed by primary union except for a superficial infection.

These cases seem to indicate that it is not necessary, and is even inadvisable, to drain the abdomen in patients with exudates from the small intestine, for nature takes care of the peritoneum very nicely while there is apparently less resistance in the subcutaneous tissue.

TREATMENT OF FRACTURES OF THE FEMUR IN ADULTS

Dr. Roderick V. Grace read a paper with the above title, for which see page 279.

Dr. H. H. M. Lyle said with regard to open operation, it seemed to be the general opinion that this field had been lessened by the successful employment of skeletal traction. He has noted that many of the plated cases have a great deal of stiffness and limitation of motion in the knee-joint. This is due, he believes, to three factors:

1. The trauma and damage to the muscle by the original lesion. 2. To the trauma of the operation. 3. To long immobilization.

It is extremely important, in plated cases, that early movements of the knee are begun as soon as the wound is healed, otherwise a stiff knee will result in a fair number of the cases. Skeletal traction has another distinct advantage in that it can be used as a preliminary measure in dragging down bony fragments and stretching out the muscles so that a reduction of the fragments can be made.

Dr. J. M. Hitzrot could not agree with Doctor Lyle that disability in the joints was a necessary adjunct of the treatment of a fracture of the femur by a steel plate. Movement in the joints can be practised early by the use of the splints devised by the speaker and reported before this Society in 1912 and in 1914 (Johnson's Surgical Therapeusis). In fact the fractured femur could be out of bed in the ambulatory splint in from three to four weeks after the operation in selected cases.

In any discussion of fracture of the femur the age incidence must be considered. Cases from birth to twelve years. The results are good if the axis of the limb is corrected and gross overriding attended to by a varying number of methods, and growth will take care of the shortening as all well know. Between 18–35 to 40, especially in robust muscular individuals, the problem is different.

Skin traction is not efficient in any except the rare instance. That is especially applicable to this group. Reduction by manipulation under an

anæsthetic, if done immediately after the fracture, will also give a favorable result in properly selected cases, namely, the transverse fractures in which the fragments can be brought end-to-end. The number of these cases is also infrequent. By far the larger number, however, cannot be satisfactorily handled by the above means.

Fracture of the femur is a serious injury. At present there is too much assurance that if the overriding is corrected that that is quite sufficient, and once that is accomplished that everything has been done. Emphasis should be laid upon the fact that the preservation of the normal axis of the femur in its weight-bearing line for each individual is of as great if not greater importance than slight degrees of lateral displacement or overriding. That is, the normal femur is never a straight bone. It has a varying curve or curves. Anything which alters this normal curve will result in disability and this disability will increase with time due to the secondary changes which result in the hip, knee and ankle. The speaker has followed cases since 1912 to note the effect of this disability and angular deviations from the normal axis have produced disabilities which should be preventable if this deviation from the normal axis had been given the proper attention.

There is no question about the value of skeletal traction, however, he himself had not been favorably impressed by the results which were being obtained due perhaps to the faults in the correction of the axis of the femur above discussed. In 96 cases of fracture of the femur treated by skeletal traction in the Metropolitan area, reviewed for the purpose of estimating the industrial disability, only four had results which could be classed as entirely satisfactory, of the remainder many had to be given a disability rating of from 60 to 100 per cent. of the involved leg due to varying degrees of disability. The disability involved the knee-joint, the thigh muscles, and the foot (weak foot). There was also a varying degree of angular deformity with deviation from the normal axis in far too many cases to consider the method as used as correct. Naturally any method improperly used cannot give the most desirable result. The point to be emphasized is that skeletal traction is not a simple method. It requires skill and training and a proper understanding of the result to be accomplished, before it can be used intelligently. The impression extant that when tongs, etc., are applied to the femur and the overriding corrected, the deed is done and will result in no great advance in the treatment of the fractured femur. Correctly used, it is a distinct advance and will and should supplant most other methods for fractures of the shaft of the femur.

With regard to the open operation and the use of the steel plate in fractures of the femur, wisely used in selected cases it is of the greatest value especially in the group of cases most difficult to correct because of powerful muscles, interposition of soft parts, etc. Operation is seldom required under twenty and should rarely be used over forty. It is not a

method to be used by the occasional surgeon, who is not properly equipped and it is a nice point to decide which surgeon has that equipment. That there are men so fitted that they can and do use the steel plate and the open reduction with great satisfaction cannot be disputed. To the surgeon who has any doubt about the matter, the only admonition which can be given is, don't use the method, use any other method, because safety first is better than regret after. The time of operation is also of the greatest importance, there is a marked difference between operations done before the twelfth day and those done after fifteen or twenty days. The early operations disturb the normal bone formation but little, whereas, the operation later interferes with the normal sequence of bone repair and the plates causes trouble. This disturbance in the normal sequence of events in bone repair is emphasized by Hey-Groves as one of the chief factors in non-union and delayed union.

While he held no brief for the bone plate, Doctor Hitzrot felt it had a distinct place in the treatment of the shaft of the femur. He was not prepared to give exact figures, but he had used the plate in approximately 100 cases, with one death and two infections, which necessitated the removal of the plate. All three cases were improperly selected and he would not now operate in similar types. In the remainder there were no non-unions, no stiff knees, no plates removed and except for the muscle atrophy in the line of the scar, no changes in function or in the anatomy worthy of note.

After forty, operation is probably never indicated because of the danger connected with the operation, and in the older people that method should be selected which would fit the needs of the case, that is, the treatment should take in the patient as a whole and not the femur alone.

Some disability is almost unavoidable after fifty, no matter what the treatment or how skillful and this fact should also be recognized, as it is recognized in such frequent fractures as those at the base of the radius.

Doctor Grace has spoken of excessive callus formation in one of his cases which he attributes to the plate. Doctor Hitzrot's impression was that the plate was loose and because it was loose its movement produced irritation at the fracture line and interfered with the normal bone production and condensation, hence the failure in union.

With reference to the period of disability as related to the complete restoration of function: complete function is not restored until the joints and especially the muscles have regained their full activity and this will always vary with the willingness of the patient to actively use the muscles of the involved leg. No other method will completely restore the muscle power, except active intentional methodical use. Statements that weight-bearing was allowed on such and such a date and the consideration that the cure is accomplished when that is possible without support, are extremely misleading and of no value in estimating the completed result. The rate of the bone repair will vary but very little in any given series if not inter-

fered with, but the rate of the muscle power return will depend to a large degree upon the coöperation of the patient. The willing workers will have the short periods of disability, the willing shirkers will have the long periods of disability.

Dr. Harold E. Santee said at Bellevue, on the Second Division, in the past ten years there have been 134 fractures of the femur below the trochanteric region, of which 118 were simple fractures. This period has been one of evolution in treatment and of progress. In this evolution of treatment from Buck's extension, to skin traction and plaster, to skin traction with suspension, to skeletal traction with suspension, it is only fair to state that excellent results have attended the use of any given method in chosen cases. The difficulty is to prophetically choose the cases for any type of treatment except skeletal traction. Certainly the latter treatment gives the maximum and most adequate control of the fracture.

With skin traction, it has been practically impossible to use over twenty pounds for any length of time. Occasional cases have held for a short time at twenty-five to twenty-eight pounds but never for long. This will not reduce many fractures of the femur.

Skeletal traction gives practically unlimited poundage; moreover when applied to the femur itself, it is applied at its maximum efficiency. For this type of traction in femoral shaft fractures, the Finochietto band has been used in six cases—not satisfactorily; the Steinmann pin in twelve cases—two through the femur, ten through the tibia for low femoral fractures. Forty-eight cases were tonged; eight at least were reapplied for slipping or poor placement. The complications met with and possibly attributable to the method have never been early—but rather late and equally attributable to intercurrent infections except in two cases. They are four in number—one an erysipelas with abscesses of scalp and both eyelids at one week developed a streptococcic knee on the side tonged after one month. His tong wounds showed a staphylococcus. His knee-joint cultured a hæmolytic streptococcus. Naturally tongs were removed. His ultimate result was a stiff knee and two inches shortening. A second case with multiple associated injuries developed after two weeks a general erythematous dermatitis and hæmolytic streptococci were recovered from his tong wounds and from Finochietto band wounds in the other leg. His tongs were removed. Neither of these two cases is directly attributable to tongs. Of the other two cases, one had a pustular dermatitis and one no such complicating factor. Both developed staphylococcus infection around the tong wounds and popliteal space sufficient to stiffen the knee. Both were mobilized under anæsthesia twice each and obtained over 90° flexion with full extension. Both showed shortening after removal of the tongs.

The results as to shortening shown on the following records of 41 cases are: no shortening, 13; one-half inch or less, 7; one-half to one inch, 8;

one to three inches, 3; fibrous union, 3. Lengthening occurred three times, one-half inch, three-fourths inch, one and one-half inches.

In the use of skeletal traction which permits of maximum control of the fracture one's standards of judgment and self-criticism should be correspondingly high. According to such standards, many cases had been failures, but on analysis such failures are more those of application of the method than of the method itself.

Dr. John J. Moorhead stated that three or four years ago at the Surgical Section he reported a series of femur cases treated by skeletal traction. Except for fractures of the neck of the femur, he regarded skeletal traction as indicated under four conditions: (1) When there was shortening of an inch or more; (2) in heavy muscled subjects; (3) in cases seen after twenty-four hours; (4) in the supra-condylar group. He called the above the irreducibles because in his hands nothing except skeletal traction or open operation would overcome the deformity. He preferred the nail to other forms of skeletal traction. To prevent the infection over the protruding nail ends he uses a wet dressing of iodine saline, that is one dram of iodine to a pint of saline solution.

Skeletal traction has made it unnecessary for him to do any form of open operation in recent years, and even in old cases osteotomy and skeletal traction at the same sitting made this troublesome group amenable.

Dr. Howard Lilienthal said there was one point about plating simple fractures that he wished to mention. Many surgeons have had accidents during or after this procedure, but those depending on infection can be avoided by plating the fracture with the Lane plate and using a screw with an extended shank, leaving the wound wide open and beginning the Carrel-Dakin treatment at once. The plate should be in place for three or four weeks. At the end of that time a sufficient amount of new bone has formed so the plate can be painlessly removed. Then the fracture should be dressed with plaster-of-Paris. The speaker has had good results with this method. He has never had to take out a plate before the end of the four weeks and he has had no failures, although some of his patients with open fractures were desperately ill from previously existing infection. He wished it understood that he referred only to those cases in which it was necessary to plate. He began the physiotherapy at the earliest moment.

Dr. John C. A. Gerster said that where skin traction had failed to overcome shortening, skeletal traction has been successfully employed as late as fourteen to eighteen days after the fracture, and shortening was overcome. In one case, a completely healed fracture with three inches of shortening was operated on, the fracture reëstablished and by strong skeletal traction (nail extension) shortening was overcome and union took place. In another case with compound comminuted fracture of both bones of the leg, fracture of upper third of femur and compound fracture-dislocation of the elbow, skeletal traction was applied to femur for three weeks. This prevented

shortening but did not control angulation of upper fragment. Plating was done to correct this. Four years later the man was drafted and sent overseas, his fracture, etc., not having resulted in any disability. He still has the plate in his thigh. As to the length of time of leaving the skeletal traction, the speaker had left it in twenty-eight to thirty-five days and had no infection. He did not use wet dressings but used aristol and collodion. As to the removal of the nail in cases where one is not sure the callus is solid enough to hold the bone, if one uses Hackenbruch turn buckles with a plaster spica divided opposite the site of the fracture, the distraction of the two parts of the spica can be performed before removing the nail extension, thus maintaining correct position before release traction.

DOCTOR GRACE, in closing the discussion, said that death in some of these cases might be due to fat embolism. He believed in the importance of preserving the anterior bowing of the thigh and tried to have flexion of the knee early.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held November 2, 1925

The President, Dr. Edward B. Hodge, in the Chair

IMPROVED SUPRAPUBIC DRAINAGE APPARATUS

Dr. Benjamin Thomas exhibited an apparatus which with various modifications had been in use in his hospital services for the past ten years. It consists of metallic, bevelled-edged cup, having a Y-like drain, one arm of which leads from the dome, the other from the lower portion near the rim. In the concavity of the cup, screwed to the drainage exit, is a detachable metal tip to which is attached a rubber tube for introduction into the bladder. To the stem of the Y rubber tubing is attached leading to a bottle under the bed or if the patient is ambulatory, to a rubber bag strapped to the thigh. The cup is held in position by a belt passing around the abdomen; this is made to be easily detachable to the exterior of the cup. Through eyelets near the brim of the lower extremity of the cup, a rubber perineal tube or cord passes between the legs and is tied to riders on the belt at the level of the iliac crests.

The saving in the cost of gauze and cotton by this apparatus in suprapubic cystostomy is enormous.

The cup as it stands to-day has certain definite dimensions. These are necessary in view of the fact that the distance between the central drainage area and the lower part of the cup must be shorter than the distance between this drainage exit and the top; otherwise there will be too much impingement on the symphysis resulting in excoriation of the skin. The distance from the centre to the bottom is 5 cm. and from the centre to the top is 6 cm. The width is 7 cm. A material advantage of this cup is that if there occurs leakage around the tube entering the bladder, the urine escaping into the concavity of the cup drains out the lower arm near the brim and in this way all drainage will be taken care of.

The central metallic attachment is removable, with the tube entering the bladder, usually at the end of two days. The latest improvement has been this rubber cushion ring recently provided by Eynard, of Paris, which can be sterilized by an antiseptic solution or by boiling for one minute and has the advantage of lessening the excoriation and making the patient more comfortable and permitting of less leakage. Nine out of ten patients can be kept dry by this drainage apparatus; occasionally, in large fat individuals, or in exceptionally thin patients, we find some difficulty.

2. *New Prostatectomy Lobe Forceps.*—These forceps are similar to the usual stone forceps, except that they have heavy teeth so that when the lobe is grasped there will be no slipping. The main feature making the forceps useful is that the tips of the blades are fairly thin, and it is easy to slip the blade between the prostate and the false capsule; in the case of Young's forceps the tips are too blunt or "bull-nosed." These forceps are also used suprapubically in removing prostatic lobes from the bladder or prostatic urethra.

3. *Prostatic Bar Punch.*—This instrument is a punch which is to be used suprapubically. It is essentially a giant-sized Gartman's tonsil punch. One is often unable to punch out the obstructive bar at the neck of the bladder with Young's punch. In such case this instrument will be found useful. Occasionally there is a great deal of bleeding following the punch operation, but if the punching is associated with a cystotomy, one has it under control and hæmostatic measures can be applied immediately. Moreover, if there be a bad cystitis, efficient drainage can be instituted and lives saved.

COMPLETE EXTIRPATION OF THE PENIS

DR. THOS. C. STELLWAGON presented two cases. In one case the carcinoma of the penis that had involved the urethra and both groins was so extensive that he was passing urine through a number of sinuses. A complete extirpation of the penis was done. His cure was delayed by infection. He has gained fifteen pounds in the two years following his operation. He has complete vesical control. Previous to operation this man had had radium treatment. He had had five cases altogether, two are alive, one at five and one-half years since operation and the other at three and one-quarter years.

The second case was operated on in the Jewish Hospital in May. At the extirpation some portion of the scrotal sac was left.

In operating upon these cases he had used the ordinary circular amputation with removal of the lymph-nodes; this has been done in six cases, four of whom are alive. In cases where the growth extends to the abdominal cavity, it is necessary to go up to the bifurcation and try to remove the sheath of the vein. The more radical the operation the safer it is for the patient. He always asks the patients if they wish to retain the testicles, but he believed attempts to save the testicles left a distinct menace to the patient. In one patient where the testicle was saved, the patient later asked that it be removed, because of the physical discomfort it caused him, for he had to lift it when he wanted to urinate.

He did not mean to preach the radical operation because if one gets these cases early enough he believed one can effect cures by the ordinary circular amputation.

DR. BENJAMIN THOMAS said that he had operated on seven or eight cases of carcinoma of the penis; of these, three were total extirpations, but in all he left the testicles behind. He entered a plea for the conservation of the testicles in this operation of complete extirpation of the penis. Total

emasculation is unnecessary, is disfiguring, and extremely undesirable on the grounds that it may lead to destruction of the normal internal, if not the external, sexual characteristics, on the grounds that the testicles may possess an internal secretion. The characteristics of the Eunuch must not be forgotten.

Dr. James R. Wells referred to a case of this kind operated upon by himself. A total extirpation had been performed two and one-half years before. The man was thirty-two years of age. He stated that following his operation he had had absolutely no difference in his feelings or in his sexual life.

ECHINOCOCCUS CYST OF LIVER

Dr. Henry P. Brown, Jr., presented a man, twenty years of age, a native of South America, who came to the Presbyterian Hospital in April last, on account of pain and swelling in the epigastrium. He was referred to Doctor Allen's service, to whom he was indebted for the privilege of operating upon and reporting the case. The man first noticed in 1923 that his abdomen was getting larger in its upper part. He had no discomfort or other symptoms. About one year ago (1924), he began to have pain in the right side of the epigastrium when he worked hard or lay on his right side. There was no pain or tenderness at any other time. No jaundice, loss of weight, or gastro-intestinal disturbance. There was slight loss of strength. He can eat all kinds of foods and has no dislike for fats. There is no dyspnœa or œdema of feet or ankles. Slight cough for past three years, especially at morning and night. No hæmoptysis. Night sweats for past five years. Feels hot and flushed in afternoons. Pleural effusion without pneumonia seven years ago. No genito-urinary or nervous symptoms.

He had lues in 1924, for which he received salvarsan. He is a laborer, is single, and the family and social histories are unimportant. He has been in this country about two years. He was well developed, rather poorly nourished and presented no evidence of jaundice. The head, neck, chest, heart and lungs are essentially normal. The upper abdomen is much enlarged and palpation reveals a mass which fills the upper abdomen on both sides. It is quite hard and smooth and not tender, the impression from palpation and percussion being that it is an enlargement of the liver and spleen, meeting in the midline. Dulness in the flanks is present and there is an impulse transmitted through the mass on tapping the abdomen.

The temperature, pulse, and respirations on admission were 98.3–90 and 20, respectively. Wassermann positive and urine analysis essentially normal. Blood count showed red blood-cells 3,820,000, white blood-cells 6800 and hæmoglobin 76. X-ray reports that: "On right side there is a marked flattening of the diaphragm, loss of cardiophrenic and costophrenic angles. Upper border of diaphragm reaches to sixth rib. Below diaphragm on right side, extending over toward left side, is a uniform shadow, in upper central portion of abdomen. Impossible to give any detail of this shadow." An exploration was done. The liver was greatly enlarged and in the anterior and diaphragmatic surfaces there presented a large cyst which rose above the substance of the liver. The wall of the cyst was smooth and tense. After walling off the intestines and peritoneal cavity it was aspirated, clear colorless fluid being evacuated. One small typical daughter echinococcus cyst escaped, and four quarts of fluid were removed from the main cyst cavity. A rubber tube was sewn in for drainage, a piece of the wall removed for the pathological laboratory and marsupialization done. The finger could not palpate the depth of the cavity, it being about 10 to 15 cm. deep.

In spite of slow evacuation of the cyst contents, his pulse rose to 160, coming down in twenty-four hours to 112. There was a moderate post-operative febrile reaction which subsided in four days.

He drained profusely and it was not till the twentieth post-operative day that daughter cysts began to appear. He was discharged from the hospital July 8, sixty-five days after operation, at which time the cavity held two ounces, pieces of cyst were occasionally recovered and a small drainage tube was still in place. His cyst cavity had been irrigated daily with Dakin solution.

He was treated in the dispensary for eighteen days, during which time the drainage became more profuse and daughter cysts were recovered at each dressing. He had no discomfort, was feeling well and was anxious to be readmitted and have an attempt made to close the cavity.

Thinking that it might be possible to enucleate the wall of the mother cyst, the reporter reoperated upon him on July 24, 1925. The external opening of the sinus tract was dissected free and the cyst cavity opened and explored, the peritoneal cavity having been walled off by adhesions. The cyst cavity extended upward toward the diaphragm to about the level of the sixth rib on the right side. Its lining felt thick and leathery and contained many crypts. It was considered inadvisable to attempt to remove the lining and the cavity was wiped out with gauze and a large rubber tube sewn in place. Patient reacted satisfactorily from the operation and second-hour irrigation of the cavity with Dakin solution was instituted. The daughter cysts continued to be discharged quite freely for a few days and then began to show disintegration, the last one being seen on the ninth day after irrigation was begun.

He was discharged on the forty-eighth day, having only a small sinus which discharged very slightly. October 29 he was seen and his sinus had entirely closed, the abdominal wall was strong and there was no evidence of a recurrence.

Doctor Brown presented a second case in the person of a woman, a native of Armenia, aged thirty-two years, who was admitted to the Presbyterian Hospital in Dr. E. H. Goodman's service May 5, 1925, on account of colicky abdominal attacks with vomiting, from which she had been suffering at intervals for a month. There was also a mass to be felt to the right of the umbilicus, which has increased in size. The first attack of pain lasted about one week and then disappeared. It has since then occasionally returned for short periods. She first noticed the mass in her abdomen four years ago, at which time she says it was much smaller than when her physician saw it in April. She has never been jaundiced and her bowels are somewhat constipated. She has always been well except for some dysmenorrhœa. Has not lost weight.

Her abdomen was flat and scaphoid, no tenderness or rigidity. There were two masses in the right upper quadrant, hard in consistency, each about the size of a peach, the upper one seeming to be attached to the lower edge of the liver while the lower is in the right kidney region. Both seem superficial and move with respiration, while the lower moves with pressure over the kidney region posteriorly and gives the impression of being attached to the kidney. Pressure on one mass moves the other. The rest of the abdomen is negative.

June 15, 1925, Dr. Edw. B. Hodge opened the abdomen. The ascending colon was found to be pushed to the right wall of the abdomen. Dense omental adhesions obscured a hard, firm, pyriform mass originating from the inferior surface of the right lobe of the liver. The base of the mass extended into the hepatic tissue. While attempting to release the mass there was sud-

denly released a large quantity (about 400 c.c.) of clear straw-colored fluid, and from the rupture in the wall of the cyst there was released many small cystic bodies, typical of echinococcus. The cyst was packed off from the rest of the abdomen and the opening enlarged, evacuating about eighty to one hundred daughter cysts, varying from 2 mm. to 5 cm. in diameter. The mother cyst extended upward into the liver, toward the left lobe. The gall-bladder was apparently normal. The inferior of the cyst was scraped with gauze and marsupialized to the peritoneum. A cigarette drain was placed under the liver and the cyst cavity tightly packed with gauze. The wound was closed in layers.

The patient made an uneventful recovery, the gauze drain being removed in five days and a rubber tube substituted. There was at this time a good deal of sanguinous discharge, the patient being quite comfortable.

Fifteen days after operation she was discharged with a small rubber dam in the cyst. From this point she was treated by her family physician.

At examination made October 29 the sinus was found to be closed; the patient to be in good health; there is no evidence of recurrence.

Dr. Edward B. Hodge remarked as to the second case reported by Doctor Brown, that there were two distinct masses present, on palpation. One was in the convex border of the liver and the other was lower down, a little lower than where we ordinarily find the enlarged gall-bladder.

The upper mass was firm and tender, and he thought it was carcinoma of the liver. It turned out to be all one cyst. This was the first case of the kind that he had ever had.

Replying to Doctor Ashhurst's question as to whether this cyst was recognized as an echinococcus cyst at operation, he said that he did not know it was before operation, but recognized it at that time. If the sinus had not healed he had intended to formalize.

Dr. A. P. C. Ashhurst said that most patients with hydatid cyst, who are treated simply by evacuation and drainage have recurrences if they are traced long enough. Experiments have shown that every element of the contents of an hydatid cyst may be an infectious medium and hence the cause of recurrence. Quénu (1902) adopted the method of formalization, aspirating the cyst through a very fine needle and injecting the cyst until distended with one per cent. solution which is allowed to remain for five minutes. After evacuation of the formalin, the cyst may be obliterated by sutures. No recurrences are to be anticipated after this treatment; and he believed if the method were better known, it would be more used.

PARTIAL HYDRONEPHROSIS CAUSED BY PRESSURE FROM DOUBLE URETER

Dr. Henry P. Brown, Jr., presented a woman of twenty-eight years, who was admitted to the Gynæcological Service of the Presbyterian Hospital, May 21, 1925, on account of pain in the left flank, from which she had suffered for the past eight years.

This pain was referred to her left side, just below the twelfth rib in the posterior axillary line. The pain comes on irregularly every two weeks to six months and usually lasts from eight to twenty-four hours. It is quite

severe at times and causes her great distress. The pain does not radiate along the ureter, it always remaining localized. She has never taken morphia to relieve it. The attacks are gradually becoming more severe and more frequent, the most recent one having occurred one month ago and lasting twenty hours, the one preceding this having been about one month before. Urination was not painful and there was no frequency or urgency. Hæmaturia or pyuria had never been observed.

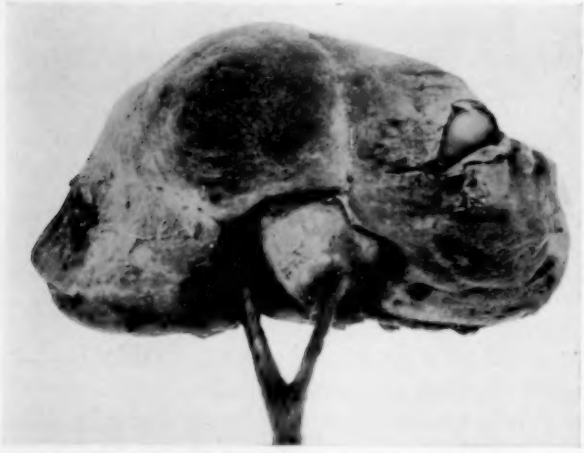

FIG. 1.—Shows ureters untwisted. Cystic portion extends to line of branch of ureter on left.

The sight of food causes nausea during an attack of pain, often accompanied by vomiting. There has been no gaseous eructations and no indigestion before or after the attacks. Bowels are regular without cathartics and there has been no blood or mucus in the stool, nor has she had any fever, chills or sweats.

She was a rather poorly developed, under-nourished, visceroptotic type of young woman in no apparent distress; good color, no jaundice, dyspnœa or cyanosis; skin warm, smooth and moist without noteworthy lesions.

The head, neck and chest with their contents are essentially normal, aside from a large pair of tonsils. The blood-pressure is 105/65. The abdomen is scaphoid and no masses or tenderness are elicited. The liver, spleen and kidneys are not palpably enlarged, and there is no costovertebral tenderness. Reflexes are normal and the extremities are likewise negative.

FIG. 2.—Natural position showing constriction of ureter to lower segment.

The urine varied from 1010 to 1020 for specific gravity, albumin was never present and there were occasionally a few white blood-cells present. The blood showed red blood-cells 3,700,000, leucocytes 14,400 and hæmoglobin 74 per cent. Blood urea nitrogen was 18 mgs. P.S.P., first specimen of 110 c.c. showed 45 per cent., second of 90 c.c. showed 20 per cent., a total of 65 per cent. Blood Wassermann was negative.

After repeated cystoscopic examinations with pyelograms and skiagrams the conclusion was reached that she had a movable left kidney, with renal

colic from pelvic distention, without obstruction in the lower ureter when recumbent.

May 5, 1925, by the usual oblique loin incision, the kidney was exposed. It was found to be freely movable, contained a fair amount of fat in the pelvis, and was not very adherent to the peri-renal fat. It was readily exposed and found to be moderately enlarged and contained a large cystic mass in its lower two-thirds. The mass was aspirated and about four ounces of clear urinous fluid was removed. The whole mass collapsed and there remained a small amount of kidney substance at the upper pole. The ureter was clamped and a pedicle clamp was applied to the vessels, the kidney removed and the ureter and vessels ligated. A cigarette drain was inserted and the wound closed. She made an uninterrupted recovery and was discharged on the sixteenth day after operation. At that time a P. S. P. showed, first specimen, 400 c.c. with 25 per cent., second specimen 90 c.c. with 15 per cent.

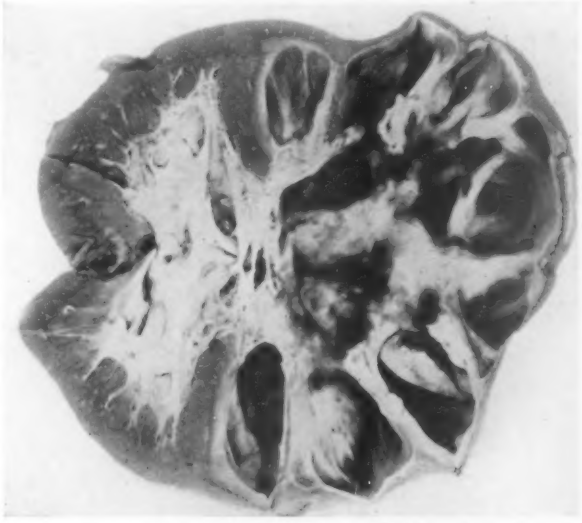

FIG. 3.—Shows cyst, with remnant of normal kidney tissue at upper pole. The pelvices did not communicate.

The laboratory report by Dr. John Eiman, is as follows:

Specimen consists of a kidney 13.5 x 6.5 x 6 cm. Capsule strips fairly easily and leaves a pale reddish, smooth surface. Fetal lobulations are fairly distinct. There are two ureters, one joining the other 2.5 cm. and 6 cm., respectively, from the point of origin. The shorter limb of the ureter leads into a distinct funnel-shaped pelvis. The two ureters were twisted in such a way as to cause obstruction of the shorter limb. The dilated pelvis is continuous with an irregular cavity which roughly occupies little more than one-half of the kidney and must have been produced by back pressure of urine leading to dilatation of the pelvis, calices and atrophy of the renal substance. The longer fork of the ureter drains the other, upper, pole of the kidney. This part of the kidney shows no gross lesions. The two branches of the ureter communicate with two separate and distinct pelvices, hence the obstruction in one limb produced hydronephrosis in that portion of the ureter drained by the obstructed ureter.

Microscopically: Low-grade chronic interstitial nephritis and dilatation of the capsule of Bowman, indicating effects of back pressure on all parts of the kidney.

For the privilege of operating upon and reporting this case, the reporter was indebted to Dr. E. B. Hodge, in whose service she was treated. A letter received from the patient to-day, six months later, stated that she had never had a recurrence of her former trouble. "After leaving the hospital I rapidly regained my strength and have felt better in the last five months than in the preceding eight years. I have called myself cured."

Dr. Leon Herman thought that the pyelographic medium could not enter the dilated pelvis in this case, the ureter being completely obstructed. However, it is advisable in doing pyelography to withdraw the catheter slowly while the medium is being injected with which method one is more likely to demonstrate reduplications of the upper ureter. He preferred to block the lower ureter with a large catheter and inject the urinary tract with the patient in the Trendelenburg posture; this insures complete filling of the tract with the exception of those parts that are closed off. The presence of an abnormally small pelvic shadow in the pyelogram is always indicative of the presence of a congenital anomaly of the upper ureter and pelvis. If the presence of a small pelvis had been demonstrated in the case under discussion, the surgeon would have been quite justified in suspecting the presence of reduplicated pelvis.

As regards the possibility of partial resection in cases of double kidney, this will depend to a large extent upon whether the ureters have separate or communal blood supplies. In this case with high division of the ureter and the presence of a normal kidney on the opposite side, he thought the removal of the kidney was clearly indicated. The probabilities are that a resection would have resulted badly; the retained segment would in all probability have suffered gradual atrophy.

SOLITARY CYST OF KIDNEY

Dr. George M. Laws presented a woman, age sixty years, who was admitted to the Presbyterian Hospital in April, 1924. She had a movable cyst in the right abdomen which was known to have been present for at least six years without much increase in size. During this time she had suffered from backache in both renal areas, worse lying down, and occasionally quite severe. The tumor was not tender. Vaginal examination excluded any connection with the pelvic organs. There were no urinary symptoms. Cystoscopic examination showed the bladder and ureteral orifices to be normal. There was no pelvic retention. Specimens of urine, collected by ureteral catheters, were practically identical on both sides, showing a few leucocytes and excretion of approximately equal amounts of indigo-carmine. An ureterogram was made and the patient discharged the next day.

She was readmitted in April, 1925, having noticed an increase in the size of the tumor within four months, during which time she had had pains in both flanks, "like labor pains," every few days, and more recently severe pain in the thighs. X-ray showed calcification of blood-vessels and mild degree of osteoarthritis of the spine. Blood and blood chemistry were practically normal.

Dr. John H. Girvin operated through an abdominal incision and found the thin-walled cyst to be dark blue, about 4 inches diameter, and its contents to be a clear, amber-colored fluid. He did a transperitoneal nephrectomy which required the ligation of an aberrant artery at the upper pole of the kidney. Operative recovery was complicated by a temporary aphasia on the tenth day accompanied by high blood-pressure.

The diagnosis of cyst of the kidney having been confirmed by the ureterogram, showing displacement of the ureter, it seemed that polycystic disease could be excluded by the facts that the cyst was unilateral; that it developed

late in life; had a smooth outline; kidney showed good function; no septa were shown by X-ray. As between solitary cyst and hydatid cyst the hydatid is described as fixed and non-fluctuating. Had a complement fixation test been done it would have helped to eliminate hydatid cyst and narrowed the possibilities down to a fairly positive diagnosis of solitary cyst. Furthermore the presence of advanced arterial sclerosis is a point in favor of solitary cyst, since these formations are probably caused by sclerosis. However in the reported cases the diagnosis has rarely been made.

The specimen (Fig. 4) consisted of a kidney, 17 x 8 x 5.2 cm. At one pole there is a cyst which has been opened and measures approximately 10 cm. in diameter. The wall of the cyst is thin and on the inner surface shows dense fibrous tissue trabeculæ. The inner lining is pale, glistening and smooth. The cyst does not communicate with the pelvis of the kidney. The kidney is firm in consistency. Capsule is slightly, but uniformly thick. The fetal lobulations are fairly distinct. The capsule strips with difficulty and carries with it real substance, leaving a rather coarsely granular reddish to yellowish surface. Section does not bulge. Cortex measures 5 mm. Medulla about 17 mm. Color of the cortex and medulla is reddish to yellow. Renal vessels are markedly sclerosed and stand out like pipe-stems. There are excessive amounts of fat in the pelvis. The lining of the pelvis and calyces is for the most part smooth, pale and glistening. A few areas, however, show hemorrhages. At the pole opposite to that containing the cyst, there is an aberrant artery.

Microscopic Examination: Simple solitary cyst of the kidney. Low-grade chronic interstitial nephritis and marked arterio-sclerosis.

FIG. 4.—Solitary cyst of kidney.

ABSCESS OF URACHUS

DR. ALEXANDER RANDALL presented a man, forty-one years of age, who was admitted to the Philadelphia General Hospital, September 26, 1919, on account of a swelling in the lower abdomen. He had had an attack of specific urethritis five months before, but the condition apparently cleared up under treatment without any complications; no history of any other serious illness or operations; urinary function has always been normal. Four or five days before admission he first noticed a painful swelling in the midline of the lower abdomen below the umbilicus; since then he had been increasingly indisposed, has had a fever, but no definite chill; has had some slight frequency of urination associated with terminal pain.

In the lower abdomen was found a large swelling situated between the symphysis pubis and the umbilicus; it is prominent to the eye and on touch is firm, rather fixed, round, smooth and tender, and is oblong in shape. It measures approximately 14 x 9 cm., the larger measurement in the longi-

tudinal axis of the body. There is no evidence of any connection or attachment to the bladder and the mass feels some larger and more superficial than a distended bladder would. The urine as voided by the patient contains shreds. Urinalysis negative, 1018. No stone felt in the bladder. Cystoscopic examination revealed an area of peculiar bullous œdema in the vertex of the bladder with a central area of increased hyperæmia. In the actual centre of this was seen a pencil of white material hanging into the bladder cavity, which was waving back and forth by the flow of the irrigating fluid. It measured approximately 3½ to 4 cm. in length by 6 or 7 millimetres in diameter and appeared similar to a pencil of tooth paste being squeezed from its tube. On this finding a diagnosis of infected urachus was made.

October 6, 1919, operation. An attempt was made to free the abscess mass in toto without opening up the peritoneum with an idea of complete bloc excision. However, as is usual in such urachal lesions, the walls were found to be exceedingly thin and their approximation to the peritoneum was intimate so that separation was impossible. A simple incision was therefore made and the cavity packed with iodoform gauze. Culture of the pus was subsequently reported from the laboratory as infected with Friedlander's bacillus.

The patient made an uneventful recovery except for an abscess in the scrotal wall which was opened and drained. Granulation of the large abscess cavity was slow and it was not until two months had passed that closure of the large drainage area had granulated completely. There was also a separation of the recti muscles and for this reason it was necessary to fit the patient with a proper lower abdominal belt to prevent an incisional hernia.

TUMOR OF URACHUS

Doctor Randall presented a man, aged thirty-nine years, who was admitted to the University of Pennsylvania Hospital, June 18, 1925, on account of pain at end of urination.

In August, 1924, the man had an operation for hemorrhoids, since which time he claims not to have been free from pain. For three months this pain was located in his stomach, unrelated to meals, dull and continuous. In October, 1924, he first noticed pain at the end of the urinary act, which became sharp and burning, and at the same time he developed frequency of urination, having to rise two or three times each night. There was a slight terminal hæmaturia at times, but frequently a terminal pyuria. His upper abdominal pain left and a suprapubic soreness developed which was increased at the end of urination and radiated down the urethra. The pyuria seems to have been intermittent and the hæmaturia at no time severe; the symptom of pain was improved when the pyuria was present. During the last few weeks the onset of urination has been difficult and the amount of urine passed scant. He has lost ten pounds of weight during the past month. There have been no other local or subjective symptoms or signs.

Physical Examination.—The general physical examination presents nothing of interest or bearing on his local condition. Rectal examination reveals a small, firm prostate which is not tender. Above the prostate pressure causes an increase in his hypogastrium pain. Following this examination the desire to void occurred and the patient passed three ounces of clear urine, followed by a small amount of pus. The end of the act was accompanied by an excruciating pain, which caused the patient to double up, and lasted for a period of a minute or more.

Cystoscopic Examination.—The bladder contained no residual urine; had

a capacity of four ounces or more; bladder wall covered with normal mucous membrane except in the fundus, where was found a lesion situated in the neighborhood of four or more centimetres back of the interureteric bar. This lesion measures approximately 2½ cm. in diameter; it is surrounded and bordered by healthy mucous membrane devoid of inflammatory reaction and appears as a shaggy brown mass bulging through a stretched and dilated orifice. The picture is one that suggests some extra-vesical body which is ulcerating its way into the bladder cavity.

Two diagnoses were suggested: 1st, a degenerated gumma of the bladder wall; 2nd, a foreign body. Bearing in mind the history of the patient having had an operation for hemorrhoids, from which he dated the onset of his present complaint, it was thought possible that a sponge had been lost at that operation and was ulcerating its way into the bladder cavity. Efforts were made to obtain the details of this operation to determine whether or not it was a simple "clamp and cautery" procedure or a more extensive resection such as a Whitehead operation. These details could not be obtained. X-ray was taken of the bladder and showed a rather circular-shaped mass apparently extra-vesical and supporting innumerable trabeculi of calcareous character outlining the tumor mass.

June 28, 1925, operation. Suprapubic incision. As soon as the recti muscles were separated it was evident that the condition was one of urachal disease, an elongated tumor mass, the size of a child's fist, immediately being palpated. Realizing the close attachments of these tumors to the peritoneum, excision was started near its umbilical attachment; peritoneal acvity opened, the posterior bladder wall mobilized following the method of Voelker, and as soon as possible, the peritoneum freed from the posterior bladder surface and the peritoneal cavity closed. The mass was resected from the summit of the bladder with 1½ cm. of healthy mucous membrane about its periphery. The bladder was closed about a large mushroom catheter as a drain, and the abdominal incision closed about this. Convalescence was satisfactory, although healing of the wound unusually slow.

July 24, 1925. A catheter was placed in the bladder *per urethram*, and only by sidetracking the urine by this means was the bladder fistula closed three days later. The patient was discharged from the hospital August 21, he having been retained for a month in order to carry out deep X-ray therapy following suprapubic closure.

Description of Specimen (Doctor Bothe).—The mass measures 9 x 5 x 3 cm. The surface is smooth and appears to be covered with a limiting membrane. At one or two points it is quite irregular and from one end oozes gelatinous material (apparently the intravesical area). On section it was found to be fairly firm, due to fibrous bands and in between these fibrous bands are large deposits of colloid material. There are also scattered deposits of a calcareous nature. Microscopic section shows considerable mucoid material, some fibrous tissue and free blood. Scattered throughout are collections of epithelial cells, the general arrangement of which are glandular and these cells are large going from a cuboidal to a columnal type. The appearance of these cells is that of a malignant cell. Diagnosis: Mucoid carcinoma.

PYELOGRAPHY IN RENAL DIAGNOSIS

Dr. Leon Herman read a paper with the above title, for which see page 227.

CORRESPONDENCE

INTESTINAL OBSTRUCTION FROM DIRECT TRAUMA

EDITOR ANNALS OF SURGERY:

Sir:

Acute intestinal obstruction resulting from a general peritonitis caused by traumatism of various kinds is, of course, a more or less common occurrence, but acute obstruction caused by direct traumatism without the presence of infection and particularly obstruction which requires operative interference is of rather unusual occurrence. Traumatism of the intestines resulting from contusions of the abdomen and excessive manipulations during abdominal operations often does cause symptoms of obstruction, but the usual methods of procedure, morphine, poultices, etc., are practically always successful. Whether the paralytic ileus is due to a contusion of a segment of bowel or to a reflex phenomenon is a matter of conjecture and not a matter of vital importance. In either case there is an absence of infection. The following case it seems to me represents an illustration of this type of obstruction:

F. W., a factory engineer, fifty-six years of age, of fairly robust build, caught his left arm between the leather belt and the pulley over which it ran. He could not extricate it, and his body was dragged over the pulley before the machinery could be stopped. The case was first referred to Doctor McPherson, who found a compound comminuted fracture of the proximal end of the left ulna with an anterior dislocation of both the upper fragment and the head of the radius. The seventh, eighth, ninth and tenth ribs on the left side in the posterior axillary line were also fractured. Aside from a moderate degree of shock, physical examination otherwise was essentially negative. A plaster bandage was applied to the arm and the left chest strapped with adhesive plaster.

For the following four days the patient presented no untoward symptoms, having about one degree of fever, a pulse of 80 to 90, of fair quality, and slightly accelerated respirations. His abdomen was noted to be somewhat distended, but soft. On the fifth day after his injury he began to complain of abdominal discomfort, which was relieved by the passage of considerable flatus, induced by poultices and low enemas. Vomiting of small quantities of brownish fluid began, however, on the sixth day, and when seen in consultation at that time, the evident picture of an intestinal obstruction was presented. The facies was characteristic, but the abdomen, though markedly distended and tympanitic, was not particularly tender, and there was no demonstrable flank dulness. The pulse was slightly accelerated, but temperature and respirations were practically as above noted; there was a leucocyte count of 17,800 with 80 per cent. of polymorphonuclear cells.

The chest findings at this time were also interesting; clinically the signs over the left lower lobe posteriorly were those of a rather large cavity formation; röntgenologically the conclusions were a left-sided consolidation about a pulmonary abscess.

In spite of these findings the abdominal picture was, of course, an absolutely distinct entity. Although the cause of the obstruction was perhaps of minor importance in the determination of treatment, it was worthy of theoretical consideration.

The first thought naturally was a general peritonitis with paralytic ileus resulting from one of several possibilities.

1. From a small perforation through the diaphragm of either the ninth or tenth fractured ribs.

2. From a small perforation in the intestine caused by the crushing injury which his abdomen must have directly sustained.

3. A peritonitis due to the irritation from a slow hemorrhage from some viscus with secondary infection; this seems the least probable. Incidentally a mesenteric thrombosis could not be ruled out but it seemed a remote possibility. The pulse, temperature and blood count could all be easily accounted for by the lung abscess; to what extent might they be influenced by the abdominal condition was a matter for conjecture. As an alternative to the peritonitis theory was that of a paralytic ileus caused by a severe abdominal and intestinal trauma without the presence of any actual lesion, or better without the presence of infection. One strong argument against this theory would seem to be the fact that the ileus had not been relieved by medical means and that the man was dying from intestinal obstruction.

The treatment of the obstruction was obvious and simple; an enterostomy was performed under local anæsthesia. On opening the peritoneal cavity about one ounce of clear serum escaped and a loop of distended, acutely red, small intestine presented itself. A limited digital exploration of the abdominal cavity revealed no evidence of adhesions and as far as could be determined there was no perforation of the diaphragm. It was considered inadvisable to insert any drainage into the free abdominal cavity.

The subsequent course of the abdominal condition was quite satisfactory, liquid stools were passed on the eighth and soft solid evacuations on the tenth days, the abdomen at this latter time being soft with no distention. After eight days of marked post-operative improvement in the patients' general condition a severe cough developed with the expectoration of pus and blood accompanied by a septic temperature and a fatal termination took place on the sixteenth day after the enterostomy.

At autopsy an abscess and extensive gangrene of the lower lobe of the left lung were found, to which area pleural adhesions were attached and considerable exudate was present over the pleural site of the fractured ribs. The peritoneal cavity showed no evidence of peritonitis, the intestinal tract was negative throughout with the exception of the jejunal wound and its immediately associated pathology, namely the adhesive peritonitis gluing the gut to the abdominal wall and the somewhat contracted intestine just distal to the enterostomy. The diaphragm was also negative.

In summarizing the evidence in this case of general peritonitis *versus* direct trauma without infection as the cause of the intestinal obstruction, we find that the most suggestive arguments against the former are, first, the presence of simply clear serum in the peritoneal cavity on the sixth day after injury; second, the fact that cultures of this serum showed no growth; third, the abdominal condition cleared up completely after operation, and fourth, there was no evidence of peritonitis or intestinal or diaphragmatic perforation at autopsy.

There was no positive pathological evidence of direct trauma to the intestine but its absence does not exclude the diagnosis.

THACHER W. WORTHEN, M.D.,
Hartford, Connecticut.

FIBROMA OF THE MESENTERY

EDITOR ANNALS OF SURGERY:

Sir:

Fibromata of the mesentery are reported with sufficient rarity to warrant the contribution of a single case.

Fibroma, a common connective tissue tumor, has been found so rarely in the intestinal mesentery that it has not been a subject of consideration by pathological texts, and has, as yet, been reported with insufficient frequency

for the establishment of an occurrence rate, either for mesenteric tumors or hospital admissions.

A review of the literature, initiated by Greer [1] and completed and summarized by De Courcy and Maloney,[2] renders a total of not more than forty cases reported in one hundred years. This case corresponds to the analysis on the part of the above authors in (*a*) location, (*b*) symptoms based on partial obstruction and (*c*) occasional necessity for resection.

Mrs. I. H., age thirty-seven, white, complained of recurrent attacks of cramp-like pain in the right iliac region, accompanied by moderate constipation, considerable sense of weakness, gaseous indigestion and headache. These attacks had occurred over a period of a few years with increasing severity, lasting two to four days each time and usually exhibiting an interval of several weeks. The attendance of many physicians had given practically no relief but had resulted in bringing out that tenderness was present constantly over the appendix region.

Seen two days after the onset of an attack of pain, nausea and constipation, the patient exhibited an essentially negative physical examination except for marked tenderness, and production of nausea on pressure, over McBurney's point. No röntgenological examination was made.

Operation under a diagnosis of "appendicitis" disclosed a normal-appearing appendix and a dense pale growth in the mesentery of the ileum about four inches from the ileocæcal valve. The tumor was within the mesentery, in apposition to the intestinal wall and had puckered the ileum into a firm U-shape, with resultant obstruction to a slight degree. The character of the growth was not recognized in the gross, and a resection of about six inches of the ileum was done, followed by end-to-end anastomosis, and appendectomy.

The pathological report stated: Firm, walnut-size tumor in mesentery, separated from wall of ileum by pad of fat. Microscopic structure, fibroma. Appendix normal. (Dr. W. P. Stowe.)

The immediate recovery was uneventful and six weeks after operation the patient reported greater abdominal comfort than had been experienced for years.

WARREN WOOD, M.D.,
Rochester, N. Y.

[1] Greer: Brit. Med. Journ., 1911, October 28.

[2] De Courcey and Maloney: Surg., Gynec. and Obstet., 1925, vol. xl, p. 402.

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ANNALS *of* SURGERY
227-231 So. 6th Street
Philadelphia, Penna.